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ACADEMY OF SCIENCES OF THE U.S.S.R.
ACADEMY OF MEDICAL SCIENCES OF THE U.S.S.R.

SCIENTIFIC SESSION
ON THE
PHYSIOLOGICAL TEACHINGS
OF ACADEMICIAN
I. P. PAVLOV

June 28-July 4, 1950

INAUGURAL ADDRESS
REPORTS
RESOLUTION

FOREIGN LANGUAGES PUBLISHING HOUSE
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Comrade J. V. Stalin

Dear Joseph Vissarionovich,

We, at this session of the Academy of Sciences of the U.S.S.R. and the Academy of Medical Sciences of the U.S.S.R. on the physiological teachings of I. P. Pavlov, desire to convey to you our ardent greetings, as a pre-eminent scientist and the genius who is the leader and teacher of the heroic Bolshevik Party, the Soviet people and all progressive humanity, as the standard-bearer of peace, democracy and Socialism and the champion of the welfare and happiness of the working people of the world.

This scientific session will go down in the history of progressive science as marking a new epoch in the development of physiology and medicine, whose mission it is in our country to conserve and fortify the health of the working people and to assist the building of Communism.

It is with deep pleasure that we all observe that this session is taking place at a time of an unprecedented general advance of science in the U.S.S.R., due to the steadily growing might of our Country, to the continuous improvement of the conditions of life of the Soviet people, and to your indefatigable and titanic activities.

Thanks to the constant care and solicitude of the Bolshevik Party, the Soviet Government and of you personally, Comrade Stalin, science in the U.S.S.R. is rapidly developing and is being continually enriched by new discoveries and achievements.

Carrying on the great work of Lenin, you, Comrade Stalin, inform science with Bolshevik spirit and purpose and render immense support to all that is advanced and progressive in science.

The great Lenin and you, dear Comrade Stalin, rendered I. P. Pavlov inestimable assistance in his work and provided all the necessary conditions for the creative development of his physiological teachings.

You, as a pre-eminent scientist, produce works which are without equal in the history of progressive science. Your work *Concerning Marxism in Linguistics* is a model of genuine creative science, a supreme example of how science should be developed and advanced. It has created a revolution in linguistics, it has ushered in a new era in Soviet science generally.

You, Comrade Stalin, pose and creatively solve most vital problems of Marxist-Leninist theory. The powerful light of your genius illumines the road to Communism.

We, like all Soviet people, are proud and infinitely happy that world progress and advanced science are headed by you, dear Joseph Vissarionovich.

This Pavlov Session, the keynote of which is criticism and self-criticism, has disclosed serious errors and shortcomings in the elaboration of Pavlov's scientific legacy. At the same time, it has outlined a grand program for the all-round creative advancement of Pavlov's teachings.

You, Comrade Stalin, constantly admonish us not to rest content with results achieved. Following your great example and your behests, we are fully aware that I. P. Pavlov's teaching is not a petrified doctrine, that it provides a scientific basis for the creative development of physiology, medicine and psychology, of rational dietetics, physical culture and spa therapy making for the improvement of the physical well-being of the Soviet citizen.

The Soviet people, and progressive humanity generally, will not forgive us if we do not put the treasures Pavlov has bequeathed us to full and proper use.

We promise you, dear Comrade Stalin, to bend all our efforts to eliminate as speedily as possible the shortcomings in the work of developing Pavlov's science, and to put it to the utmost use in furtherance of the building of Communism in our country.

Long live our beloved teacher and leader, the glory of labouring humanity, the pride and banner of progressive science—our great Stalin!

Adopted at the Session of the Academy of Sciences of the U.S.S.R. and the Academy of Medical Sciences of the U.S.S.R. on Pavlov's Physiological Teachings.

July 4, 1950

INAUGURAL ADDRESS

BY S. I. VAVILOV

PRESIDENT OF THE ACADEMY
OF SCIENCES OF THE U.S.S.R.

Comrades, last September the 100th anniversary of the birth of Ivan Petrovich Pavlov was celebrated with unusual fervour everywhere—from scientific institutions to collective farms—throughout the length and breadth of our land. The extraordinary scope of the homage paid to the memory of a scientist was undoubtedly due to the quite exceptional importance of Pavlov's teachings not only for physiology, not only for science, but for Soviet culture and life generally.

Today, nearly a year later, Pavlov's teachings have again brought us together, but not this time for anniversary celebrations, not for historical surveys and reminiscences, but for a critical and self-critical examination of how matters stand with regard to the development of Pavlov's legacy in the Soviet Union.

Pavlov's teachings are not only of immense value, they are not only a grand achievement and a supreme acquisition of science. Pavlov opened up extensive vistas for new advances in physiology and psychology, for biology and natural science in general. He discovered a highroad in science of great importance in regard both to method and results. He erected an extremely strong buttress of the materialist outlook in a question of cardinal importance. Of this question—the relation between the material and the mental, or ideal—Comrade Stalin had written in 1906 as follows:

"A single and indivisible nature expressed in two different forms—material and ideal; a single and indivisible social life expressed in two different forms—material and ideal—this is how we should regard the development of nature and of social life.... The development of the ideal side, the development of consciousness, is *preceded* by the development of the material side, the development of the external conditions: first the external conditions change, the material side changes, and *then* consciousness, the ideal side, changes accordingly."[1]

In these precepts of J. V. Stalin we find foreshadowed in very general outline the main thesis of Pavlov's theory of the higher nervous activity, in all its richness and complexity.

It was as though in echo of Comrade Stalin's thesis that many years later, in 1930, and after immense experimental work, I. P. Pavlov, in his "A Physiologist's Reply to Psychologists," summed up the main conclusion of his researches: "Man is, of course, a system (more crudely, a machine), and like every other in nature it is governed by the inevitable laws common to all nature; but it is a system which, within the present field of our scientific vision, is unique for its extreme power of self-regulation.... The chiefest, strongest and most permanent impression we get from the study of higher nervous activity by our methods is the extraordinary plasticity of this activity, and its immense potentialities; nothing is immobile or intractable, and everything may always be achieved, changed for the better, provided only that the proper conditions are created.

"A system (machine) and man, with all his ideals, aspirations and achievements—how terribly discordant a comparison it would seem at a first glance! But is this really so? Even from the generally accepted point of view, is not man the pinnacle of nature, the highest embodiment of the resources of infinite nature, the incarnation of her mighty and still unexplored laws? Is this not rather calculated to enhance man's dignity, to afford him the deepest satisfaction? And everything vital is retained that is implied in the idea of free will, with its personal, social and governmental responsibility. . . ."[1]

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[1] J. Stalin, *Anarchism or Socialism,* Eng. ed., Moscow 1951, pp. 32-33.

This conclusion, formulated by Pavlov six years before his death, is, nevertheless, by no means the ultimate limit, the last word. Actually, it sets an immense program before physiological science. Pavlov opened a new and highly important road in science, and mapped it for a long way ahead. This is the immortal service he rendered his socialist country and all progressive mankind.

It is the duty of Pavlov's heirs, his pupils, collaborators and successors, to develop to the best of their ability the achievements of the genius of their teacher. This is essential if science is to proceed properly; it is particularly essential for the science of a socialist state. We have learned and are accustomed to plan research. We may not be in a position to foresee the creative achievements of a Mendeleyev or a Pavlov, but from the summits of the work they have accomplished we may discern expansive vistas enabling us to plan science rationally. It is our duty to follow the Pavlov path, that most important and unmistakable path he has blazed and traced for us. It opens up new and quite distinct prospects of enormous significance for theory and practice.

In Pavlov's lifetime the Soviet Government created unprecedented conditions for the advancement of his work. On Lenin's initiative the Council of People's Commissars set up a special committee to provide him with the conditions he needed, and a government decree was issued to this effect. The government founded two research institutes for his benefit—the Physiological Institute of the Academy of Sciences in Leningrad, and the biological station in Koltushi, which Pavlov called "the capital of the conditioned reflexes." "I should like to live for years and years," Pavlov wrote in 1935, "because my laboratories are flourishing as never before. The Soviet Government has donated millions for my scientific work, for the building of laboratories. I am moved to believe that the measures for the encouragement of physiologists—and I, after all, am a physiologist—will accomplish their purpose, and that my science will particularly flourish on our native soil...."[1]

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[1] I. P. Pavlov, *Complete Works,* Vol. III, p. 454. (Unless otherwise stated, all references are to Russian editions.—*Ed.*)

Fifteen years have elapsed since these lines were written. Pavlov is no longer with us. The immense assistance accorded by the Party and Government, and by Comrade Stalin personally, to the development of physiology in our country has since continued on an ever greater scale. In addition to the institutes I have mentioned, physiological institutions have been founded in Moscow, Leningrad and other cities, and we now have an Academy of Medical Sciences, whose theoretical work is principally based on physiological research. Physiological work in the Soviet Union has today assumed enormous scope.

But can we say that the progress of Soviet physiology since Pavlov's death has been commensurate with the paramount significance of the legacy he has bequeathed us? Beyond question, the scientific output of Soviet physiologists in this period has been very large. The extensive Soviet literature, the books and journals devoted to physiology published in the past fourteen years, bear witness to this. Nor can it be denied that much of this work has been very important and significant. But have Pavlov's pupils followed the road—that highly productive and fertile road, as I have said—which Pavlov marked out? As far as a nonphysiologist can judge, the work of the Soviet physiologists concentrated in the bigger scientific institutions has deviated considerably from Pavlov's teachings. There have been attempts—not too frequent, happily—at an erroneous and unwarranted revision of Pavlov's views. But, more frequently, the ideas and work of researches have not kept to the highroad, but wandered into byways and fieldpaths. Strange and surprising though it may seem, the broad Pavlov road has become little frequented, comparatively few have followed it consistently and systematically. Not all our physiologists have been able, or have always been able, to measure up to Pavlov's straightforward materialism. They have sometimes preferred roundabout, but more conciliatory ways of their own.

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[1] I. P. Pavlov *Complete Works*, Vol. I, p. 31.

That Pavlov's theory has always encountered open or concealed opposition in the bourgeois countries is quite understandable, the chief reason being that it is a theory which by its very nature is profoundly materialistic. When Ivan Petrovich was still alive, in 1933, almost in the same year that foreign physiologists officially conferred upon him the honourable title of "princeps physiologorum mundi," Sherrington, one of the oldest leaders of the English physiologists, wrote: "But, strictly, we have to regard the relation of mind to brain as still not merely unsolved but still devoid of a basis for its very beginning." This moved Pavlov to say in the intimate circle of his disciples: "He [Sherrington] says bluntly and quite distinctly that we have not even a basis, not even the slightest basis, for a solution of this problem. That can be the only explanation why this man has in his late years become a confirmed dualist and animist."[1] Sherrington was seconded by some of the American physiologists. Liddell, for instance, considers that Pavlov's theory of conditioned reflexes should be shelved, and that only his method, his technique of elaborating conditioned reflexes may be useful. Expressions of opinion of this nature have been quite numerous and are probably well known to you here at this session.

On the other hand, some new and highly important trends of work suggested by Pavlov, above all, his theory of the second signal system, have been very little developed by us. I shall confine myself to only one, but very significant, example. As you know, in the past few weeks there has been a broad discussion in the columns of *Pravda* of materialist linguistics. Not one of the specialists who took part in the discussion even mentioned that Pavlov's theory opens up quite new paths for a study of language from the standpoint of natural science, as Ivan Petrovich himself pointed out in his time. No mention was made of this highly important problem because in fact practically nothing has been done in this direction.

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[1] *The Pavlov Wednesdays*, Vol. II, p. 446.

Has anything been suggested in the science of physiology, and primarily in the theory of the higher nervous activity, of greater or, at least, of equivalent value to Pavlov's teachings? If there had been, it might have served as some justification for the temporary departure from Pavlov's line. But as far as nonphysiologists—myself, for instance—are aware, nothing has been, either here or abroad.

Comrades, we have only clearly to realize what a situation has arisen in physiology in our country as a result of such an attitude, and it will be quite obvious that the time has come to sound the alarm. The development of modern natural science since the time of Galileo has always owed its strength to its continuity. The scientific legacy bequeathed by predecessors served as a step, a springboard, to the next stage, and in the needed, the most effective direction, theoretically and practically. Our people, and progressive humanity generally, will not forgive us if we do not put the wealth of Pavlov's legacy to proper use. In its development lies the foundation for a deeper understanding of the most complex forms of life, and for new advances in medicine.

It is anxiety for the future that has induced the Academy of Sciences and the Academy of Medical Sciences of the U.S.S.R. to convene this session. We hope that after the introductory speeches and reports have been made you will take the floor and in a spirit of bold criticism and self-criticism express your opinion of the lines Soviet physiology must follow for the further advancement of Pavlov's teachings.

The scientific public of the Soviet Union, the millions of Soviet intellectuals, were deeply stirred by the contribution recently made to the discussion of linguistics by our great leader and teacher, that master scientist and friend of science, Comrade Stalin. In this article, J. V. Stalin sounded the reminder: "It is generally recognized that no science can develop and flourish without a battle of opinions, without freedom of criticism." These words should be our guide. Comrades, I exhort you to make this session the occasion for a constructive battle of opinions, for free criticism, without regard for established authorities, undeterred by long-standing traditions, and irrespective of persons.

May our deliberations become a turning point in the development of Soviet physiology and help to remove the obstructions that are blocking its advancement. There can be no doubt that it is only by a return to Pavlov's road that physiology can be most effective, most beneficial to our people and most worthy of the Stalin epoch of the building of Communism.

Glory to Pavlov's genius!

Long live the leader of peoples, our great scientist and preceptor in all our major undertakings, Comrade Stalin!

SPEECH

BY I. P. RAZENKOV,

VICE-PRESIDENT OF THE ACADEMY
OF MEDICAL SCIENCES OF THE U.S.S.R.

The Great Stalin epoch has been marked by brilliant victories of the Soviet people in the building of Communism in our country. The productive forces of Socialism are multiplying, its culture is developing, Soviet science is progressing.

Soviet scientists owe all their achievements to the unfailing solicitude displayed by the Party and the Government, and by our beloved leader and teacher, Joseph Vissarionovich Stalin.

The prime and cardinal task of this session is to make a critical survey of what has been accomplished in our country in developing Pavlov's legacy, to ascertain whether we are going about the right way to advance the teachings of the great physiologist, and how far we have succeeded in putting Pavlov's ideas into practice, especially in our socialist health service.

Lenin and Stalin, the great leaders of the Soviet people and of all progressive humanity, deeply appreciated the creative and innovatory work of Michurin and Pavlov, and displayed a paternal concern for the development of their ideas. Under Comrade Stalin's guidance, as we know, Michurin's advanced theories won a decisive victory in the battle led by his most worthy disciple, Academician Trofim Denisovich Lysenko, against the reactionary idealist trend in biology—Weismannism-Morganism. Today the whole power of the Michurinian doctrine has been placed at the service of our socialist agriculture.

The application of physiology to practical medicine was I. P. Pavlov's life work. He himself led the way in applying to medicine the achievements of physiology which are summed up in his masterly theory of "nervism," of the laws of the higher nervous activity.

Today there can be no doubt in anyone's mind that Pavlov's teachings must be made the foundation of the whole edifice of medicine.

This, too, is the conclusion to which we are led by the results of the discussion that has been going on among our medical workers for many months. But this discussion has also revealed that our workers in theoretical and clinical medicine are still not applying the progressive ideas of our eminent physiologists, Sechenov and Pavlov.

The blame for this lies primarily with Pavlov's immediate disciples and successors, who to this day are not observing their great teacher's precept that physiology must be placed at the service of public health. More, we cannot shut our eyes to the fact that some of Pavlov's disciples are deviating from his line of work and are endeavouring to combine eclectically his ideas with those of Western scientists who are fundamentally hostile to the materialist spirit of the great physiologist's teachings.

Up till now, Pavlov's pupils have not fought hard enough and have not come forward in a united front to defend Pavlov's materialist teachings against the reactionary assaults of men like Sherrington, Lashley, Fulton and other Western idealist physiologists. More, anti-Pavlov views have been cultivated even in our own country. One cannot, for instance, ignore the essentially hostile opinions of Academician Beritov, who has long been notorious as an opponent of Pavlov, and who has striven to supplant his progressive materialist teachings by an eclectic hodgepodge of behaviourist ideas.

The responsibility for the unsatisfactory treatment of Pavlov's legacy is shared by the Presidium of the Academy of Medical Sciences, for it has so far not succeeded in uniting the Soviet physiologists as a body and directing their activities into fruitful lines of development of Pavlov's teachings.

The Medical Academy, which has a number of physiological institutes that should be working for the fruitful advancement of Pavlov's theories, cannot boast of any great achievement in this highly important field. The Institute of Experimental Medicine is characteristic in this respect. It transpires that quite a large part of the work of this Institute, with which Pavlov was associated for more than forty years, has nothing to do with the development of Pavlov's legacy. A large part of the responsibility for the state of affairs in this Institute lies with its former director, Professor L. N. Fyodorov.

The Pavlov Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity, of which Academician L. A. Orbeli is the director, has not put the work of developing Pavlov's ideas regarding the genesis of the higher nervous activity on the level it deserves. Quite the contrary, this Institute, as was revealed at the historic session of the Lenin Academy of Agricultural Sciences in 1948, was a stamping ground of Morganist-Weismannists, the trend of whose work ran counter to the basic ideas of Pavlov's theory of the inheritance of acquired, conditioned reflexes.

We all hoped that L. A. Orbeli would carry on Pavlov's work and fruitfully develop his great teachings. Unfortunately, our hopes have not been justified.

Another physiological institute of the Medical Academy, of which P. K. Anokhin, one of Pavlov's disciples, is the head, has only very recently made an attempt to reconstruct its scientific work in the direction of developing Pavlov's teachings. How far this reconstruction is real, the near future will show. Until now, the Moscow Institute of

Physiology has been nothing but an aggregation of separate laboratories, each working on the particular individual trend of its director, based upon theoretical and ideological principles differing from Pavlov's.

P. K. Anokhin himself, who has been guilty of many a serious deviation from Pavlov's teachings, has had an infatuation for the fashionable reactionary theories of Coghill, Weiss and other foreign authors. P. K. Anokhin's ideological and theoretical divagations were justly subjected to stern criticism at the enlarged meeting of the Presidium of the Medical Academy, and were characterized as a manifestation of obsequious worship of foreign science and as cosmopolitism.

The Institute of General and Experimental Pathology is headed by a prominent disciple of Pavlov's, Academician A. D. Speransky. But Speransky's trend professed to be something specific, new and distinct from Pavlov's.

I must, by way of self-criticism, say something about myself. I too am a disciple of Pavlov's, and therefore I share responsibility with all his other disciples for the way his legacy has been treated. What the Academy of Medical Sciences has done in the past five years for the development of Pavlov's legacy cannot be regarded as conforming with what the Party and the Government expected of our Academy.

With a view to advancing Pavlov's teachings, the Government decided to found a new institute, the Institute of Physiology of the Central Nervous System, and appointed as its head a prominent disciple of I. P. Pavlov, our highly esteemed Academician K. M. Bykov. The choice was not accidental, for it is generally recognized that K. M. Bykov is doing much to develop Pavlov's theories, working on the highly important problem of the connection between the cortex and the internal organs—the problem of the exteroceptive and interoceptive conditioned reflexes, which is of great value in the study of the etiology and pathogenesis of many diseases.

The unsatisfactory thing however is that these achievements of K. M. Bykov and his co-workers are still not being adequately applied to clinical practice.

What are the reasons for the unsatisfactory state of affairs in regard to the treatment of Pavlov's legacy.

There are, it seems to me, two reasons. One is lack of criticism and self-criticism in our scientific work, forgetfulness of the fact that "no science can develop and flourish without a battle of opinions, without freedom of criticism" (Stalin).

The other and no less important reason for our slowness in advancing Pavlov's teachings is that our workers to a certain extent hold aloof from the problems of practical medicine. We theoreticians are often not sufficiently aware of what practical medicine requires of us, nor do we draw general conclusions from its achievements.

We must realize the deep responsibility that lies upon us in connection with this joint scientific session. Our Soviet people, who, as our dear Ivan Petrovich used to say, respect and honour science, are one in this, that they expect us, Soviet scientists, as servants and patriots of our great Country, to cope with credit with the task of fruitfully developing our science, in conformity with the demands which Comrade Stalin makes of science.

Our task is to make a critical survey of all that has hitherto been done for the advancement of Pavlov's teachings. We must, without regard for persons, disclose and criticize the serious shortcomings in our scientific work, in order to help rectify its mistakes and direct it along the correct road. Our criticism must be constructive and comradely, and have nothing in it of the stunning sledgehammer spirit which our Party has always condemned.

After our deliberations, we must outline the concrete tasks and problems of planning our physiological work in accordance with the requirements of socialist development, practical medicine, and the building of Communism in our land.

We have a particular responsibility with regard to the education and training of our student youth, for whom Pavlov had a warm love, and to whom he addressed his historic message. We must compile physiology textbooks and manuals of genuine scientific value, based upon Pavlov's theories. It must be confessed to our shame that our students still use translations of foreign textbooks, which propagate an ideology in physiology which is not ours. Textbooks written by some Soviet authors, on the other hand, the one edited by Professor Babsky, for instance, underrate the importance of Pavlov's teachings and expound them superficially. They display nothing of the Bolshevik partisan spirit in combating manifestations of physiological idealism. Physiological idealism, as we know, has become very virulent of late abroad, where the lackeys of imperialism are harnessing physiology to the service of reaction and idealist obscurantism, against which our teacher Pavlov fought so passionately all his life.

These are the fundamental tasks we have to tackle at this session. Permit me to express the confidence that, with the never-failing assistance of our great Party, of the Soviet Government, and of our dear and beloved leader, Comrade Stalin, we shall cope with these tasks successfully.

Long live the great Soviet people, leader of the struggle for world-wide peace!

Long live our glorious Bolshevik Party, inspirer and organizer of the victories of the Soviet people!

Long live the progressive science of the Soviet Union and our great and peerless scientist, Comrade Stalin!

DEVELOPMENT OF THE IDEAS OF I. P. PAVLOV

(TASKS AND PERSPECTIVES)

REPORT BY
ACADEMICIAN K. M. BYKOV

A NEW STAGE IN PHYSIOLOGY

Modern medicine is to a large extent based upon biology, and the laws of biology are, therefore, the theoretical groundwork for the treatment of all cardinal problems of medical theory and practice. But inasmuch as it is the all-round study of the *human* organism with which the medical sciences are concerned, medicine, both in its theoretical and practical aspects, also rests upon what are known as the humanitarian sciences. For this reason, every attempt to base the theory of medical science only on biology or only on psychology, has led, and will always lead, to a crude mechanistic world outlook and, in the final analysis, to sterile idealism and fideism.

Biology has always been an arena of ideological controversy and the controversy became particularly fierce with the birth of scientific biology, that is, with the appearance of Charles Darwin's fundamental work—the most progressive theory of its time. We ourselves have seen how in the Soviet Union the battle for the materialist principles of the Darwinian theory has culminated in the triumph of the Michurinian biology, which is based on the advanced philosophy of materialism.

At the same time a decisive blow was struck at reactionary idealist theories by that outstanding representative of biological science, Ivan Petrovich Pavlov, the physiologist, when he gave practical demonstration of the correctness of the new and higher stage of development of our views on the organism, which postulate that it must be regarded in integral unity with surrounding nature. This synthetic conception of living nature followed from a correct conception of the basic properties of the vegetable and animal kingdoms.

With the theory of evolution as his basis, Pavlov built a new physiology, the science of the functions of the animal organism—from the primitive function of excitability of living matter to the highest manifestations of the life of the organism, its mental activity. Being, in his ideological outlook, a materialist, Pavlov was able in his profound scientific investigations to rise to broad generalizations in the solution of some of the most intricate problems of natural science.

How immense the significance of Pavlov's work is for all fields of science was brought out at the Pavlov Centenary Session. Yet to this day there are many who do not appreciate the full value of his great work.

The belief that all Pavlov did was to make a contribution to physiology or add another chapter to that science must be condemned as fallacious. It would be far more correct to divide all physiology into two stages—the pre-Pavlov stage and the Pavlov stage. The history of psychology may be divided in a similar manner. The pre-Pavlov psychology is based on the idealist outlook; Pavlov's psychology is essentially materialistic.

This division into stages also holds good today for such sciences as morphology, especially the morphology of the nervous system.

Pre-Pavlov physiology followed in the wake of the so-called classic physiology of the West-European trend, which interpreted the complex nervous phenomena from the idealist position of analytical physiology. Indeed, it could not be otherwise. The conditions in which science develops under capitalism preclude the possibility of disclosing the interconnection of events and facts in the development of life and science. Refusal to see the class roots of the various views on things is characteristic of West-European and American scientists; they, when assessing the importance of science for practice, speak of the "conservatism of the forces of nature," thus impeding the development of man's all-penetrating mind. It was this narrow-mindedness and defence of bourgeois class interests that gave rise to the fallacious idea of the invariability of the plant and animal organism.

The more highly perfected functions of the animal organism could not be investigated and understood from the standpoint of primitive materialism. Nor was it possible to transcend the bounds of the analytical method of investigation, because synthesis presumes the recognition of a progressively developing nature that is knowable if approached with the only correct method—dialectical materialism. The efforts of our Russian scientists to overcome the limitations of the analytical method were successful only thanks to the achievements of the Soviet system and to the new view that science must be interconnected with practice and must serve the whole people.

The new synthetic physiology was broached more than fifty years ago by a representative of the progressive circles of Russian society, the democratic enlighteners—K. A. Timiryazev, that eminent materialist and natural-scientist who established the fundamental laws of the relation of solar energy to terrestrial life and the chlorophyll of plants. The great Russian physiologist, I. P. Pavlov, succeeded in making the transition from analytical to synthetic thinking in connection with fundamental problems of animal and human physiology.

It was not without justification that Pavlov towards the close of his life, when replying to the celebrations in his honour and recognition of his importance to world science, wrote: "Yes, I am glad that, together with Ivan Mikhailovich [Sechenov], I and my dear collaborators have won for the mighty realm of physiological research the whole and undivided animal organism, instead of some vague half. And this is entirely our incontestable Russian contribution to world science, to human thought in general."[1]

These words of Pavlov reflect all his aspirations and the whole course of his scientific researches and achievements, which were based upon an integral conception of the activity of the animal organism.

Even as early as the period when he was studying the problems of blood circulation and digestion Pavlov was sharply opposed to the mechanistic trend in physiology (J. Müller, Du Bois-Reymond, etc.) which had predominated since the middle of the nineteenth century, and which led to crudely vulgarized ideas of the functions of the organism and reanimated diverse vitalistic conceptions.

Already at that period, even though the researches of the eminent physiologists of the second half of the nineteenth century were remarkable achievements for their time, Pavlov could not believe that these lines of investigation were correct and adequate for the solution of the most difficult and important problems of physiology. When he was studying the physiology of blood circulation in the laboratory connected with the clinic of S. P. Botkin, the founder of modern scientific medicine, Pavlov employed not only the method of vivisection, but also his new method of using an intact and healthy animal organism for the study of physiological functions. He brought this new method of experimentation to a particularly high level of perfection in the second period of his activity, in his study of the digestive processes.

Pavlov's study of this important branch of physiology not only disclosed the internal mechanism of the nervous processes investigated in his laboratory; it enabled him to pass to a new branch of research—the physiology of the cortex of the cerebral hemispheres, the outcome of which was the creation of the science of higher nervous activity, which immortalized his name and laid the foundation for modern medicine and biology.

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[1] I. P. Pavlov, *Complete Works*, Vol. I, p. 27.

It was at the beginning of the present century that Pavlov wrought this revolution in science. Of this remarkable period, he has himself said: "The irresistible onmarch of natural science since the time of *Galileo* made its first noticeable halt before the study of the higher parts of the brain, or, more generally, the organ of the most complicated relations of the animal to the external world. And it would seem that this is not without reason, that this really is a crucial point in natural science, since the brain, which in its highest form—the human brain—created and creates natural science, here itself becomes an object of natural science."[1]

Appraising Pavlov's work on the physiology of the brain, our outstanding physiologist, A. A. Ukhtomsky, wrote: "One is moved to repeat the historical phrase: 'Twenty-three centuries look down upon us.' " It seemed no easy thing to add anything new to so ancient a field of human knowledge. Yet Pavlov created a new science of the activity of the most complex and important organ of the higher animals and man. At the same time the "genuine physiology" of the brain that he created became the foundation for a materialist psychology. The mechanisms of cerebral activity, for which poets, psychologists and philosophers had long been groping, received their first real explanation in the works of Pavlov, and the road was opened for experimental study of the most complex psychic processes on the basis of a materialist interpretation of the so-called mental phenomena. This movement initiated by Pavlov in science is truly immense. The time has come for universal recognition and

I. P. Pavlov, *Complete Works*. Vol. III, p. 95.

profound appraisal of the significance of Pavlov's work. It is important to know the path the great physiologist followed, so that we may carry on what he began, add to its extent and depth, and apply it in practice, as the great scientific innovator himself did.

One of the most important phenomena of the animal organism is the *reflex*. All processes, in their normal course, are effected with the aid of reflexes. A large number of reflexes inborn in man and animals were known before Pavlov. Pavlov discovered a new class of reflexes, reflexes which arise in the course of the life of the individual, and which before him had remained unnoticed and unappreciated. This class is infinitely vast and important; it embraces all the reactions of animals and man, from the primitive salivary reflex in response to a sight, odour or sound associated with food, to the pronouncing of words and the use of writing. "It has been proved," Pavlov wrote, "that anything you will from the external world can be made a stimulus of the salivary glands. Any sound, odour, etc., may be made a stimulus, and it will excite the activity of the salivary glands in exactly the same way as does food at a distance. As regards the reality of the fact, there is no difference whatever, only allowance must be made for the circumstances under which the fact exists."[1]

In the words of Ukhtomsky, "Pavlov raised ... a big new problem: how is a reflex and reflex mechanism formed out of actions that take place in the organism before its appearance, before the reflex arc is established."[2]

The temporal coincidence of excitation at two points of the central nervous system gives rise to a connection between the excited points. As Pavlov conceived it, a coupling occurs between two simultaneously or successively operating sites of excitation. This idea of the coupling activity of the cerebral cortex proved fruitful for experimentation. In Pavlov's laboratory new reflexes were formed by indifferent stimuli which coincided in time with inborn unconditioned reflexes. It became possible to study the whole dynamics of the cerebral cortex with the help of newly formed reflexes, called conditioned reflexes, the path, or arc, of which necessarily passes through the cerebral cortex. Thus arose the idea and the problem of temporary connections, which have a very wide field of application in the biological sciences. At the same time Pavlov was able to cross the boundary, impassable for the old physiology, between the mechanistic idea that the phenomena of living nature were predetermined for all time, as all investigators of the functions of the living organism held, and the historical conception of development of the animal kingdom. Pavlov put forward the materialist demand that the behaviour of animals must be studied objectively, that a strictly scientific comparison must be made of the stimuli of the external world and the corresponding reactions of the animal organism. He advanced the idea and made the first attempts to prove that conditioned reflexes acquired by the individual may in the process of phylogenesis become unconditioned reflexes. "One may take it," Pavlov wrote, "that some of the newly acquired conditioned reflexes may later be transformed by heredity into unconditioned reflexes."[1]

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[1] *Ibid.*, p. 259.

[2] A. A. Ukhtomsky, *Priroda*, 1936, No. 3.

Pavlov's science of conditioned reflexes has had a powerful influence on fundamental and cardinal problems of biology, medicine, psychology and philosophy.

INTEGRITY OF THE EXTERNAL AND INTERNAL ENVIRONMENT OF THE ORGANISM

The researches of Pavlov and the hundreds of collaborators who worked under his personal direction laid the brilliant foundations of an all-important line of physiological investigation—study of the reactions of the animal organism to external factors. These classic researches have created what is actually a new physiology of the nervous system, showing the functional unity of all levels of the central nervous system, with the cerebral cortex playing the dominant role, and revealing that the functions of the sense organs, in virtue of the laws of conditioned reflex activity, are naturally connected with the functions of the brain. The conception of temporary connections has proved to be a strictly scientific criterion in the analysis of the processes taking place in all systems of the organism, both in normal and pathological states.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 217.

One of the next tasks of experimental research was to study the functions of the brain in relation to the organism's internal environment and to establish the laws governing the interrelations between external and internal factors. Pavlov had this problem in mind when he first began to study the higher nervous activity. Already in the first stages of his investigation of the relation between the organism and its environment he considered it necessary to abandon all idealistic views and pseudoscientific ideas regarding the structure of "the internal world" of animals and man. He wrote: "... this highest part [the central nervous system] controls all the phenomena taking place in the body."[1]

When studying the factors of an animal's external and internal environment, Pavlov did not separate them either in his methods of investigation or in his analysis of the nature of the processes. This unity of the external and internal in the entire activity of the organism constituted the basis of Pavlov's teaching. Here is one of his formulas: "The animal organism represents an exceedingly intricate system, consisting of an almost infinite number of parts, connected both with one another and, in the form of a single complex, with surrounding nature."[2]

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[1] *Ibid.*, Vol. I, p. 410.

[2] *Ibid.*, Vol. II, p. 452.

Pavlov always insisted that the fundamental task of physiological research must never be lost sight of. "The bourne and goal of physiological knowledge," he wrote, "is to express this infinitely complex interrelationship of the organism and the surrounding world in the form of an exact scientific formula. That is the final goal and the bourne of physiology."[1]

It is noteworthy that in the latter years of his life, when he devoted himself with particular energy to clinical problems, Pavlov laid ever-increasing stress on the importance of the internal factors in the higher nervous activity, which he defined as a continuous and component element of the physiology of the cerebral cortex. In his article "On the Physiology of the Hypnotic State in the Dog" (1932), he wrote that in additon to "a vast representation of the external world ... it gives a broad representation of the internal world of the organism, i.e., of the states and activity of the multitude of organs and tissues, of the multitude of internal organic processes."[2]

In the same year that this article was written, Pavlov again raised the problem of the internal environment at the Physiological Congress in Rome, but this time giving a positive statement of its place in the work of the brain: "The hemispheres are continually receiving countless stimuli both from the external world and from the internal environment of the organism itself.... We thus have, firstly, a most complex structure, a mosaic.... And from each separate state of the cortical cells (and there is, accordingly, an infinite number of such states) a specific conditioned stimulus may arise.... All these meet and collide, and have to be combined and systematized. We thus have, secondly, a vast dynamic system."[3]

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[1] Pavlov's *Lectures on Physiology, 1912-13,* U.S.S.R. Academy of Medical Sciences, 1949, p. 55.

[2] I. P. Pavlov, *Complete Works,* Vol. III, p. 417.

[3] *Ibid.*, pp. 487-88.

There can be no doubt that the study of this problem, to which Pavlov himself pointed, constitutes one of the most important tasks of Soviet physiologists in the work of further developing his teaching on the physiology of the cerebral hemispheres and the sense organs.

Pavlov's theory of the higher nervous activity has opened up quite exceptional prospects for a new development of medicine and psychology. Research in the application of his theory to the internal environment, and elucidation of the laws governing the interrelations between the external and internal in the activity of the organism, holds out even wider vistas in the application of Pavlov's fruitful ideas to psychology and medicine.

The first thing was to develop experimentally Pavlov's thesis that external factors influence all processes in the organism without exception through the medium of the cerebral cortex. Let us remember that the salivary gland and salivary secretion served Pavlov only as examples, by means of which he so brilliantly disclosed the general laws of conditioned reflex activity. It was necessary to demonstrate that Pavlov's conditioned reflex was universal for all the internal organs, and, what is more important, to establish the laws of *subordination* of the vegetative processes of the central nervous system to the cerebral cortex. It has been demonstrated that the activity of every internal organ is connected with the formation of conditioned reflexes, in other words, that the external environment is inseparably connected with the internal. Our work has in fact substantiated Pavlov's thesis concerning the dominant role of the cerebral cortex in the entire organism; we have discovered general and particular laws governing the functioning of the entire system of internal organs, and have traced the principal mechanisms through which the brain controls processes deeply "buried" in the body.

These researches, conducted strictly along Pavlov lines, have filled in the gap between the activity or state of an organ and the animal's conditions of life. Botkin's and

Pavlov's theory of "nervism" is gaining increasing sway in the theory and practice of medicine.

No less decisive for the elaboration of the problem of the unity of the external and internal in the activity of the organism are the researches which demonstrate the influence of the internal environment on cerebral activity.

An animal (or human being) can most effectively adapt itself to its environment when the cerebral cortex possesses the faculty of accurately and minutely detecting the various states of the systemic organs, the immediate and imminent needs of the body arising, for example, from a change of metabolism, and so on.

Our investigations based on the theory and method of conditioned reflexes have incontestably shown that signals are continuously passing from the organism's internal environment to the central nervous system, to the cerebral cortex, providing specialized information of what is going on in the systemic organs. It has been shown that these signals have a reflex influence on the functional state of the brain, with the result that all the multiform functions of the internal organs are reflected in its activity. Highly important are the definitely established facts showing that stimulation of the internal organs can give rise to a conditioned reflex, and that by their nature these internal (interoceptive) conditioned reflexes are fundamentally identical with those which Pavlov discovered in connection with external stimulation of the organism.

Contesting the idealist psychologists who sought in various ways to discredit the theory of the higher nervous activity, I. P. Pavlov (in 1932) wrote a special article entitled "A Physiologist's Reply to Psychologists." As one of the most important arguments utterly demolishing the idealist position and at the same time confirming the universality of his theory for all systems of the organism, he cited the existence of conditioned reflex signals from the organism's internal environment. "I consider it more than probable," he wrote, "that they even exist for all the tissues, to say nothing of the individual organs. In my opinion the entire organism and all its component parts are able to report about themselves to the hemispheres."[1]

It may now be said that Pavlov's hopes have been realized and that in the analysis of factors of the internal environment his theory has triumphed completely.

Investigation of reflexes (conditioned and unconditioned) from the internal environment of the body makes it possible for clinical medicine to diagnose more precisely and from the standpoint of natural science disturbances of the central nervous, the vegetative and the hormonal systems caused by morbid processes in the internal organs. It should be stressed that the application of Pavlov's teachings to the investigation of all the internal organs has enabled the discovery of special nervous mechanisms which also perform the function of "sense organs." Like the external sense organs, these internal "sense organs" serve the organism as receptors and analyzers, which maintain connection between the cerebral cortex and the organism's entire internal environment. This corroborates the conjecture of I. M. Sechenov, the father of Russian physiology, that internal (systemic) sensations and those transmitted by the external sense organs are of the same physiological nature.

Study of the influence of external factors on the processes taking place in the internal environment, and the influence of the factors of the latter on the brain, makes it possible to investigate the complex interrelations which arise in the organism in the actual conditions of its existence. We are now in a position to assert that the higher nervous activity of the animal is the result of a definite and continuous *interplay* of factors of both environments. These data and the work of L. A. Orbeli's laboratory on the sympathetic nervous system have now made it possible to bridge the gulf between the vegetative and the animal processes, and thus refute the thesis of Bichat and his present-day followers that the two spheres of the organism—the somatic and the mental—function separately and independently.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 430.

PRESENT STATE OF THE PROBLEMS OF THE PAVLOV PHYSIOLOGY

The task in the present stage of further developing Pavlov's teachings is, with the help of the combined efforts of all Soviet physiologists, to complete the fullest possible description of the mechanisms of interaction of all functions of the body under the influence of the external environment. And the point of departure must be the Sechenov-Pavlov-Vvedensky theory that the nervous mechanism is the chief link in all processes occurring in the organism, and that the organism's conditions of life constitute the determining factor of its behaviour.

It cannot be said that the workers in our medical institutions, whether theoreticians or clinicians, duly and consistently adhere to this position. It is to be regretted that the majority of the leading representatives of medicine, while they formally recognize Pavlov's teaching, in practice continue to consider the functions of the brain in isolation from the functions of the other parts of the body. One might instance many examples of an eager desire on the part of rank-and-file physicians to apply Pavlov's teachings to practical medicine, and, on the other hand, of a lack of initiative on the part of many heads of clinics, medical faculties and institutes in putting Pavlov's ideas to practical use. The pioneers and innovators in the field of medical science who are working from the standpoint of Pavlov's scientific conceptions may be counted on one's fingers. The influence of foreign bourgeois science hostile to the Botkin-Pavlov conception is still to be observed, in veiled form, in Soviet medicine.

This state of affairs is encouraged by the attitude taken by some of the physiological institutions, which have a rather narrow notion of the tasks involved in the development of Pavlov's teachings. The curricula of the physiological faculties have not been radically reconstructed to conform with the Pavlov stage of modern physiology.

Such institutions as the Pavlov Physiological Institute of the Academy of Sciences, the Pavlov Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity, the Moscow Institute of Physiology, the majority of the laboratories of the Institute of Experimental Medicine of the Academy of Medical Sciences, and most of the departments of the universities and colleges have not made the problems raised by Pavlov their paramount object of study and research. In each of these institutions, only one laboratory, and that isolated from all the other laboratories, has been assigned for the study of conditioned reflexes. They mainly busy themselves with detailizing or adding to the body of facts, the underlying principles of which were worked out by Pavlov himself. They still study variations and different ways of forming food or motor conditioned reflexes, or employ complicated electro-physiological apparatus for the registration of phenomena which at best only give a more accurate idea of already known mechanisms.

These investigations, needless to say, are of great interest, but they cannot create the conditions for a new development of Pavlov's theories, and do not solve the problems Pavlov raised. And if the researches on conditioned reflexes conducted in these laboratories are confined to already *solved* problems, and their value is furthermore depreciated by their *tardiness,* the work of other laboratories, those studying biochemical processes, the activity of the peripheral nervous system or the mechanisms of muscular activity, for example, *bears no relation to the Pavlov physiology whatever.* More, some of these laboratories are still swayed by the theories of foreign physiologists regarding the predominance of humoral over nervous factors, which Pavlov rejected. Naturally, the work of these institutions is *not* calculated to attract the proper attention of medical researchers to the new ideas in the development of advanced Soviet science.

It is to be regretted that only in the past three or four years has the Pavlov Physiological Department of the Institute of Experimental Medicine, headed by P. S. Kupalov, begun to work on the more complex forms of nervous activity. Consistent application of Pavlov's theory in the study of these reactions is capable of providing new material for an understanding of the mechanism of "voluntary" activity.

The researches conducted in Pavlov's old laboratory at the Institute of Experimental Medicine by a number of investigators who worked there during Pavlov's lifetime are of great importance, because they provide a practical refutation of the attacks of American physiologists who, from ignorance or deliberately, misrepresent and belittle the importance of Pavlov's science because it is a materialist science.

However, it should be remarked that the term "reflexes without beginning" introduced by P. S. Kupalov is liable to give rise to a false conception contradictory to Pavlov's materialist theory of the determined character of the higher (mental) nervous activity. Several opinions of this nature expressed by Kupalov are of a very dubious character.

The laboratory of E. A. Asratyan has taken up the very important problem of the role of the cortex in the restorative and compensatory processes taking place in disturbances of the animal motor apparatus. These studies develop Pavlov's theory further and refute the false conceptions of certain foreign physiologists (Bethe, etc.).

The work of the Voronezh physiologist I. N. Zhuravlyov on the physiological mechanisms of appetite and thirst is undoubtedly a further advancement of Pavlov's ideas.

The work being done at the Rostov Medical Institute by two of Pavlov's oldest pupils, N. A. Rozhansky and I. S. Tsitovich, is to some extent a continuation and development of the theory of the activity of the cerebral cortex. I have in mind, chiefly, their investigations of the connection between the activity of the cortex and the adjacent subcortical cerebral ganglia, and their work on the ontogenetic development of conditioned and unconditioned reflexes.

There was every reason to expect that the study of the phylogenesis and ontogenesis of the conditioned reflex activity of man and animals would be carried on in the vast and splendidly equipped research institute in the village of Pavlovo (formerly Koltushi), in that "capital of the conditioned reflexes," which Pavlov had himself designated to be the principal centre of the study of the genesis of conditioned reflexes.

The work at this institution since the death of the founder of the new science has not been conducted as intensively and broadly as was expected. There are several reasons for this. The loss of all the animals prepared for the experiments might be mentioned as one of them. But the chief reason is that the attention of the majority of the Institute's numerous workers has been concentrated on developing the ideas of its director, L. A. Orbeli, on the autonomous nervous system. Development of Orbeli's theories concerning the sympathetic nervous system and study of problems pertaining to what is called evolutionary physiology are important in themselves, but it must be said that they have only an indirect bearing on the problems raised by Pavlov himself. One certainly cannot deny the necessity and possibility of enlisting data obtained from a study of the physiology of the autonomous nervous system and other departments of physiology for the development of Pavlov's teachings, such as Orbeli and his co-workers are doing; but the nature and trend of their researches do not conform with the direct aims and tasks set by Pavlov and his school.

In this respect the work of D. A. Biryukov and others on the higher nervous activity of various representatives of the animal kingdom undoubtedly introduces new features into Pavlov's teachings, as far as the limited facilities of their laboratories permit. N. I. Krasnogorsky, A. G. Ivanov-Smolensky and other investigators have been long and fruitfully studying the ontogenesis of higher nervous activity in children and adults.

It is gratifying to note the appearance of Ivanov-Smolensky's book and the forthcoming publication of Krasnogorsky's book, although it must be said that both Krasnogorsky's and Ivanov-Smolensky's facilities for the study of the higher nervous activity of man were very limited compared with those of Pavlov's former clinic.

I confine myself to mentioning these works and omit other interesting researches, because the principal aim of this session is to disclose the shortcomings which hinder the fruitful development of Pavlov's ideas.

Much of the work of P. K. Anokhin produces a rather vague and confused impression. In several instances he endeavours to give his own, and often incorrect, interpretation of fundamental concepts of the theory of conditioned reflexes, as, for example, his notion of cortical inhibition. Here we see a tendency on Anokhin's part, for which he has frequently been criticized, to "correct" Pavlov's classical teachings with the fanciful theories of foreign scientists.

It must be said with regret that L. A. Orbeli, who was placed in charge of all the institutions where I. P. Pavlov worked, has not altogether performed the mission entrusted to him. He has not directed the efforts of the body of workers at his command, who were gathered together by Pavlov himself, towards developing Pavlov's specific ideas, or to combating the influence of West-European and American bourgeois theories which Pavlov continuously fought.

The fundamental principle of Pavlov's teaching is the unity and integrity of the organism. And I would again remind you, in Pavlov's famous words, that "this is entirely our incontestable Russian contribution to world science, to human thought in general."[1]

Pavlov's experimental researches enriched the Marxist-Leninist theory of knowledge, which recognizes the existence, outside of us and independent of our minds, of an objective world which is reflected in man's sensations and consciousness. The great physiologist added much to our understanding of how the "subjective image of the objective world"[2] is formed, showing that it is the effect of a complex reflex act, thus presuming the unity of the subjective and the objective, of the mental and the physical.

In his "Lectures on Problems of the Higher Nervous Activity," Orbeli ignores Pavlov's fundamental methodological principle, which furnishes the key to a correct analysis and correct evaluation of all Pavlov has bequeathed to us. In his appraisal of Pavlov, Orbeli proceeds from the theory of psycho-physical parallelism espoused by E. Hering, which holds that between the physical and mental phenomena there is an "intermediate link" of purely physiological processes.

Academician Orbeli writes: "Throughout the course of these lectures I have deliberately stressed the astonishing parallelism between the conclusions reached by Pavlov from an objective study of the higher nervous activity in the dog . . . and the conclusions drawn from the data of the physiology of the sense organs by investigators who adhered to the physiological position" (p. 124). Orbeli is here referring to the advocates of physiological idealism, Helmholtz and Wundt and the idealist E. Hering, who investigated the sense organs of man. Orbeli here commits another error when he speaks of a parallelism between the data obtained from the study of man by the objective and the subjective methods, and considers them to be of equivalent value. Orbeli further says: "Observation of subjective phenomena led Hering, as I have already said, to the establishment of the same regularity and the same fundamental laws of nervous activity as Pavlov arrived at from an objective study, and this is a guarantee of the correctness of both theories, a guarantee of the correctness of our present physiological conceptions" (p. 125).

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[1] I. P. Pavlov, *Complete Works*, Vol. I, p. 27.

[2] V. I. Lenin, *Materialism and Empirio-Criticism*, Eng. ed., Moscow 1947, p. 117.

Orbeli has found nothing in Pavlov that sharply distinguishes him from Hering and that raises him high above the "classical" physiology of the sense organs.

Orbeli again reverts to E. Hering in his paper on "The Principle of Evolution Applied to the Physiology of the Central Nervous System" (1945), this time in order to show that Pavlov supposedly duplicated and confirmed Hering's "discovery" of the principal nervous processes—mutual induction, for example.

In this paper Orbeli criticizes the method of conditioned reflexes and expresses his preference for subjective methods of research. In substantiation, I shall quote a few of his statements:

"...Indeed, if we take our stand on the materialist conceptions of dialectical materialism," Orbeli writes, "we can conceive of no other way than to utilize subjective phenomena as one of the instruments for the study of the physiology of the brain.

"In this respect we have a predecessor ... I am referring to E. Hering, who, philosophically, was not a materialist, but rather held to the principle of empirical parallelism." (P. 206.) Orbeli is not disturbed by the fact that this "predecessor" consistently advocated the idea that the evidence of our sense organs is a reflection not of an objective external world, but of the laws governing the nervous system.

In order to prove that the subjective and objective methods are of equal value, Orbeli puts Pavlov's great teaching on the same level as the subjective-psychological researches of E. Hering, and gives the latter the credit for Pavlov's discoveries. "It is extremely interesting," Orbeli writes "that a study of the physiology of the sense organs enabled E. Hering to arrive at definite conceptions regarding the nervous processes, with which to a large degree the *later* ideas of Pavlov *coincided*.[1] Suffice it to say that such phenomena as induction—simultaneous and successive—were *first* established by Hering on the basis of a study of the physiology of the sense organs." (P. 206.)

Thus, according to Orbeli, E. Hering accomplished with his subjective-psychological method what Pavlov only duplicated later with his objective method.[2]

But while placing the subjective and objective methods on a par, Orbeli goes on in the next passage to belittle Pavlov's theory of the dynamics of the cortical processes, and sets out to show that the method of conditioned reflexes has its limitations. He writes:

"In itself, the course of conditioned reflex acts enables us to compare the initial and the final links, but all the intermediate links present extreme difficulty to our observation." (P. 207.) And further: "Pavlov's genius has enabled us to disclose this dynamics of the nervous processes with great accuracy and minuteness. Nevertheless, dynamics is only dynamics, and the physiological canvas is only a canvas; on this canvas designs are embroidered, and no one is interested in the canvas alone. Everyone is interested in the carpet, which consists of the canvas and the design superimposed upon it." (P. 207.) And, as will be shown later, Orbeli and his school occupied themselves not so much with developing the heritage of Pavlov's ideas, as with elaborating problems posed by Orbeli himself.

Orbeli, too, because of his underestimation of the Pavlov heritage, naturally ignored the investigation of the interrelations between the cerebral cortex and the internal organs and tissue processes, which has found such wide repercussions in physiology and clinical medicine. For example, in their textbook on physiology for medical colleges, Ginetsinsky and Lebedinsky, two of Orbeli's closest collaborators, ignore, in pure sectarian fashion, the broad field of the interrelations between the cerebral cortex and the internal organs and tissue processes. Nor do they make any reference to such important basic processes as excitation and inhibition, which another branch proceeding from Sechenov, the school of Vvedensky, is working upon. In 1945, one of Orbeli's co-workers, G. V. Gershuni, gave an objective appraisal of the theory of the connection between the cortex and the internal organs and recognized that "the interoceptive systems must be included as a very important link in the process of interaction of the afferent systems."[1] But in 1947, writing in the *Physiological Journal* (No. 4), he suddenly changes his mind and expresses a tendentious and haughty scepticism, "denying" conditioned reflexes from the internal organs "clearly defined meaning," as he puts it.

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[1] All italics mine.—K.B.

[2] I quote these references to Hering from Orbeli's "Lectures" published in 1945. In his *Aspects of the Higher Nervous Activity* (1949), where this paper is reprinted, the author omits these references to Hering.

The negative attitude of Orbeli and his school to the vital task of developing Pavlov's legacy compels him to ignore the problem of the connection between the cortex and the internal organs, a problem which is now being investigated in many laboratories in our country.

Orbeli holds that the chief regulator is the sympathetic nervous system and the cerebellum, that is, the lower levels of the central nervous system. There can be no doubt that in the living organism any part of the central nervous system, when interacting with other parts, does to a certain extent modify their functions in one way or another, and thereby the function of the whole organism. But the all-important part of the central nervous system is the cerebral cortex, whose activity reflects a characteristic feature of the evolution of the animal kingdom. "The more perfect the nervous system of an animal organism, the more it is centralized," Pavlov wrote a year before his death, "the more and to an ever-increasing degree is its highest part the regulator and distributor of the entire activity of the organism, even though this is by no means clearly and manifestly apparent. It may seem to us that many functions in the higher animals are entirely uninfluenced by the hemispheres, but in reality this is not so. This highest part controls all the phenomena taking place in the body."[1]

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[1] G. V. Gershuni, "Twenty-Five Years' Achievement of Biology and Medicine in the U.S.S.R.," *Physiological Journal of the U.S.S.R.*, p. 62.

Is Orbeli's school doing anything to develop this cardinal problem of the science of the higher nervous activity—the active role played by "this highest part" in regulating all the functions of the organism? No, it is not. The article contributed by Orbeli to the Pavlov centenary number of the *Physiological Journal* (1949, Vol. XXXV, No. 5), "The Adaptive-Trophic Role of the Sympathetic Nervous System and the Cerebellum," begins with the following admission: "Proceeding from the ideas expressed by Ivan Petrovich Pavlov as far back as 1886 when studying the accelerator nerve of the heart ... I and my numerous co-workers studied the problem of the adaptive-trophic influence of the sympathetic nervous system on all kinds of striated muscles, on peripheral nerves and receptors and, lastly, on various parts of the central nervous system, from the spinal cord to the cerebral cortex." (P. 594.) To Pavlov's precept that the highest department of the central nervous system controls all the phenomena taking place in the body, and that it is the regulator and distributor of the entire activity of the organism, Orbeli opposes his own thesis, which holds that "the significance of the sympathetic system as the regulator and stabilizer of both the somatic and animal functions has already been fully proved and is beyond doubt." (P. 595.)

We have no intention of belittling the researches of Orbeli's school in various fields of the physiology of the sympathetic nervous system, internal secretion, external receptors and so forth. Nevertheless, the duty of developing the heritage of Pavlov's ideas and extending its influence to practice (clinical medicine, biology) has not found adequate reflection in the work of the vast body of scientists headed by L. A. Orbeli.

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[1] I. P. Pavlov, *Complete Works*, Vol. I, p. 410

I shall not stop in this report to criticize Academician I. S. Beritov's fallacious theory of the central nervous system. Such criticism has already been given in the general press and in special articles, and I hope that it will be further elaborated at this session.

Nor shall I dwell on Stern's scientifically inferior work on the so-called hemato-encephalitic barrier, which completely ignores all Pavlov's conceptions, although Stern did endeavour to bring cerebral activity into her interpretations.

Stern, in her lectures to science students, perverted Pavlov's teachings. This applies in the first place to the principle of temporary connections—the theory of conditioned reflexes—which she, like the reactionary American scientists, did not regard as physiology. She similarly perverted Pavlov's science of digestion and blood circulation.

Many other scientists have sinned in this respect in one degree or another, as may be judged from the textbooks, especially A. G. Ginetsinsky's and A. V. Lebedinsky's *Principles of the Physiology of Man and Animals,* to which we have already referred. It is a strange situation, indeed, when a Soviet textbook—more, a manual for postgraduates and physicians working for their doctorate—when such a textbook, written in Russian, contains no mention of the fundamentals of Pavlov's physiology! The textbook ignores the work of Soviet physiologists, while the teachings of Pavlov and Vvedensky are represented as second-rate scientific achievements compared with the investigations of the older physiologists of the West.

This remark is more or less true of other textbooks published in the past ten or fifteen years (the textbook edited by myself, the one edited by Babsky, and a number of textbooks for specialized schools). They all, of course, make some reference to the conditioned reflexes, but that is not the point. We all have to admit that Pavlov's synthetic physiology has placed its impress on all branches of our science. But if our entire physiology had firmly followed the path pointed out by Pavlov all the chapters would have been written differently.

SHORTCOMINGS OF ANALYTICAL PHYSIOLOGY

The fact of the matter is that many of our researchers are under the sway of certain ideas of reactionary and torpid foreign science.

It seems to me that the theory of the interaction of the afferent systems, or, say, the criticism of Pavlov's theory of inhibition, is due to a narrow understanding of the laws of development. So also, for instance, is the retrograde theory of antagonistic relations in the organism, such as the antagonistic action of potassium and calcium salts, or the antagonistic influence of the sympathetic and parasympathetic nervous systems. All West-European scientists believed in such a division, although it was quite clear that the very concept "antagonism" was borrowed from the lexicon of human relations.

Antagonism comes from a Greek word which means "to oppose" or "to counteract." We can, of course, from the point of view of the physiology of the organs, speak of mutual counteraction between the sympathetic and parasympathetic nervous systems; but as soon as we pass from isolated organs to the entire organism, very different relations come to the fore.

Synthetic physiology views the question of antagonism in the vegetative nervous system quite differently. One may speak of antagonism only in a relative sense. Antagonism and synergism are two sides of one process.

Our Russian physiologists have settled this question correctly.

The organism is a single, integral system, which in its vital activity makes very wide use of factors operating in opposite directions.

The present-day organism could no more exist normally in its highly complicated environment without the sympathetic nervous system than it could without the parasympathetic nervous system.

The law of the unity of opposites is here manifested very clearly. From the standpoint of synthetic physiology it would be simply incorrect to speak of the role of any one of the systems. At times of great physical strain, the sympathetic nervous system plays a substantial role, but if the parasympathetic system does not then come into play, the organism will be unable to perform any hard and, what is most important, prolonged work. Training consists in exercising the apparatuses both of the sympathetic nervous system and the parasympathetic nervous system in equal measure. The starting mechanism of the digestive processes is the parasympathetic vagus nerve, but after it the sympathetic system comes into action too.

Hence both systems are needed for the normal functioning of the organism. And this must be borne in mind when analyzing pathological processes.

This is why the attempt to exclude the influence of the vagus surgically in cases of peptic ulcer does not now appear to satisfy anyone, just as little as does the attempt to rid the organism of the influence of the sympathetic nervous system in cases of hypertension and other diseases.

The problem is further complicated by the fact that both systems are under the general influence of the cerebral cortex, which is also the highest regulator of all functions under normal conditions of existence.

In the past thirty years the science of hormones has been separated from general physiology and pathology to form a distinct branch—endocrinology. This separation of a particular problem from the general science of the organism as a whole has led many endocrinologists and physicians to the erroneous belief that the various hormones play a self-contained and autonomous role in the life of the organism. This belief has similarly led the humoral theory into a blind alley.

I have touched upon only a few particular cases in the life of the body, in an endeavour to show how unsound the old ideas on this subject are from the point of view of synthetic physiology.

I cannot dwell on other problems of the physiology of the higher nervous activity which are being studied in the Soviet Union or abroad. One thing, however, is certain: in spite of the very favourable conditions for scientific work existing in our Soviet country, we have done far less than is demanded for the advancement of our science.

The general state of the work of developing Pavlov's ideas is therefore far from satisfactory; and this is chiefly because the laboratories which claimed an almost complete monopoly in the field of developing the science of the higher nervous activity have not displayed sufficient singleness of purpose.

THEORY OF THE TROPHIC FUNCTION

I have already remarked that Pavlov's teachings impinge upon all branches of physiology and the related sciences, and it is therefore necessary to touch upon certain important chapters of physiology.

There is no need to dwell in detail on Pavlov's theory of the trophic function. It is generally known that the discovery he made in the course of his physiological experiments of the influence of the nervous system on the metabolic processes in the organs and tissues has played an enormous part in the development of many problems.

The trophic function has been widely studied by L. A. Orbeli in his work in physiology, and by A. D. Speransky in his work in pathophysiology. Orbeli holds that only the sympathetic system is endowed with the trophic function. This cannot be accepted as correct, because it accords neither with the facts nor with the evolution of the vegetative nervous system from the same source as the somatic nervous system.

Speransky's great achievement is that he established the fact that the nervous system plays a major role in the pathogenesis of many diseases. He has attempted to formulate a theory explaining the origin of all disturbances of the normal course of physiological reactions, that is, a general theory of pathology. It must be said, however, that the attempt has been unsuccessful, owing to lack of a proper physiological analysis. It is significant that in his monograph, *A Basis for the Construction of a Theory of Medicine,* Speransky hardly mentions I. P. Pavlov, and this means that his theory is divorced not only from the Pavlov physiology, but from physiology in general.

Let us see what Speransky thinks of the importance of physiology for pathology. On page 323 of his book we read: "Passive submission to outside leadership might easily be fatal, for it entails the acceptance of verbal analogies and the grouping of qualitatively different phenomena in accordance with some chance characteristic. Thus, instead of synthetizing phenomena, we rob them of their distinctive features, lose our freedom of manoeuvring and end up by calling in the Varangians. This has happened time and again in pathology. Who has not considered himself entitled to rule the roost in this field!"

It is plain from what Speransky says further in his book that when he talks about "Varangians" and "ruling the roost," he also has in mind normal physiology, which he would divorce from pathology. He says: "Hence the question is not one of degree, but of form, in other words, of qualitatively new biological phenomena." (P. 234.)

It is incomprehensible how a new quality can be conceived apart from degree, which, as we know, reflects the origin of a quality and, hence, its nature. It is quite clear that a pathological process is a new quality, but the degree of this quality, and hence its nature, are inseparably related to normal physiological processes. This is illustrated in the case of peptic ulcer, hypertension and other diseases, the nature of which became clear only when we began to consider them on the basis of an analysis of normal functions. It is easy to demonstrate that pathological processes cannot be studied separately from normal processes, because the same mechanisms underlie both. Permit me to recall what Pavlov said on this subject. He wrote: "Who says that pathological states of the digestive system do not come within our province? What is a pathological state? It is an encounter, a collision of the body with some extraordinary condition, or, rather, with everyday conditions but in extraordinary degree.... The organ is destroyed, and its function is lost. But this is the ordinary physiological method we employ to elucidate the role of an organ...."

And further: "If the destruction does not stop at one organ but fastens on to others and spreads, it is again the functional interrelation of organs we are studying, but from a new aspect, until we finally determine the moment when, and the mechanism whereby, the integrating power of the body as a whole is exhausted.... Is this not physiology from beginning to end, is this not delving into the relations and the functions of the various parts of the body? Only an incorrigible pedant can affirm that this does not come within our province. On the contrary, it is precisely the physiologist, whose special sphere is methodical and logical investigation of life, who is the most legitimate worker in this field."[1]

The fundamental defect in the work of the pathologists is that they ignored the idea advanced by S. P. Botkin that the nervous system plays a major role in pathological processes and, instead of embarking on a detailed and profound study of the observed facts, they began to adapt observations and facts to their old conception. Speransky and his disciples are fond of referring to the splendid researches of Vvedensky's school; yet they speak of dystrophia of the nerve trunk only incidentally and in passing, whereas, as a matter of fact, instead of passing mention, dystrophia of the nerve fibre itself deserves to be treated as a special subject, as one of the fundamentals of his conception.

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[1] I. P. Pavlov, *Complete Works*, Vol. II, p. 348.

Speransky likewise completely ignores the problem of interoception which is being so widely studied by our physiologists. After all, one cannot build synthetic theories exclusively on parabiosis or the "nervous network." What is more, all Speransky's theoretical hypotheses are presented without sufficient real analysis. The result is that the question of the humoral factors remains altogether vague even to Speransky himself.

Nevertheless, Speransky's merits are well known: he has once again, and with passionate fervour, brought the fundamental idea of "nervism" to the fore in pathology. It is gratifying to note that in Speransky's recent papers Pavlov's ideas have been treated more correctly. The next immediate task of the pathologists is to work in contact with the physiologists and to train truly scientific cadres.

THE PHYSIOLOGY OF DIGESTION

When we speak of the Pavlov physiology we mean the whole field of physiology, on which as a foundation Pavlov erected a new and majestic edifice. Pavlov had a brilliant grasp of the entire field of physiology and constantly drew upon the work of the most diverse trends and schools. He believed that the development of modern physiology demanded a knowledge and application of the most delicate and subtle physiological methods, always bearing in mind, however, that it is the integral organism that must be studied, with its highly intricate nervous organization which governs the activity both of the humoral and other systems, down to the processes taking place in the cells.

It is universally conceded that Pavlov "re-created" the physiology of the digestive system, although he himself has said that the general outline of the work of the digestive organs had already been known to science fifty years before him, adding, however, that he had approached the process of digestion from a new standpoint.

Pavlov's ideas and the tasks he outlined in the physiology of the digestive system have been very widely developed in our country. The work of the body of scientists headed by I. P. Razenkov deserves prime mention. Razenkov has made big and important contributions to this branch of physiology, because in all his researches he has been guided by Pavlov's fundamental ideas. He has succeeded latterly in discovering a connection between the activity of the digestive glands and the protein metabolism of the body.

In confirmation of the major role played by the nervous system in the regulation of the digestive process, I might cite the following new facts discovered in our laboratory.

We know that the discovery by Bayliss and Starling of the pancreas-stimulating hormone, which they named secretin, was the subject of a great deal of discussion at the time. The scales seemed to incline in favour of the recognition that humoral factors play a very important role in the activity of an organ, and independently, without the intervention of the nervous system. But now, a little more than forty years later, it has been demonstrated that secretin does act through the intervention of the nervous system.

The examples given furnish striking testimony of the triumph of Pavlov's ideas and Pavlov's methods in the physiology of digestion.

Mention should be made of the work done in this field by the Ukrainian physiologist G. V. Volborth, who is studying the mechanism of interaction of excitation and inhibition in the glandular apparatus.

Mention might also be made of other work being done in various laboratories in the Soviet Union which are helping to broaden and deepen the knowledge obtained from Pavlov's studies of the digestive processes.

It must, however, be regretfully stated that this branch of physiology, so splendidly developed in the work of our Soviet scientists, is being all too slowly applied to clinical medicine.

I should like to stress the great importance of the rhythm of motor and secretory processes in the activity of the whole body—a subject which unfortunately is still being insufficiently studied.

Just as little has been done in the study of the hygiene of nutrition, the frequency and regularity of mealtimes suitable for various age categories. Yet Pavlov's method of the chronic experiment furnishes the key to these vitally important problems. The physiologists must follow Pavlov in teaching the people how to eat and drink and preserve their working capacity and zest for life.

PAVLOV'S CONTRIBUTION TO PHARMACOLOGY

Early in his scientific career Pavlov devoted a number of researches to pharmacological problems. The work he did in the laboratory at Botkin's clinic and in the department of pharmacology of which he held the chair for several years, led him to a view of the subject which is of interest to us and of very great importance in our time. He defined pharmacology as a branch of theoretical medicine closely allied to medical practice. "As a medical doctrine," he said, "pharmacology is of course extremely important.... It must be recognized that the most universal method of treatment is the introduction of therapeutical substances into the human organism. For whatever the case, be it even obstetrical or surgical, it is almost the invariable rule that, in addition to the employment of special methods, drugs are introduced into the body. Obviously, a detailed study of this universal tool of the physician is or should be of immense importance.

"However, little by little the pharmacologist departed from his original purpose until he came to show little or no concern or interest in the therapeutic action of the substances he handled. Pharmacology naturally developed into a department of physiology, studying the effect of chemical agents on the living body and pursuing purely theoretical aims.... But owing to this circumstance the connection between modern pharmacology and practical medicine, which was, one might say, the original mission of pharmacological experiment, and a reminder of which is still preserved in the name of the science—the study of medicines—has become in many cases, at the present moment at least, weak and sometimes even purely scholastic.... This accounts for the complaints we sometimes hear from physicians against modern pharmacology. It is in the mutual interest of experimenters and physicians that pharmacology should be supplemented with elements of experimental therapy. Having to do with the sick as well as the healthy animal, and administering drugs not only in order to observe their effect in general, but also with the purpose of healing the sick animal, the pharmacologist... will, for his own sake, broaden and deepen his study of the reactions of the body to a given chemical compound, as well as his study of the body in general, and, for the sake of the physician, elucidate the actual value and real mechanism of action of the therapeutic agent.... Only if pharmacology is wedded with experimental therapy will many therapeutical mirages be dispelled, as they rightly deserve to be; on the other hand, it will preclude the sad possibility of many drugs being wrongly discarded."[1]

At the Botkin memorial meeting in 1899, Pavlov said: "When we see deviations from the normal and penetrate deeply into their mechanism, is it not natural to wish to bring them back to the normal? This is the only final criterion of the completeness of our physiological knowledge and of the extent of our mastery of the subject. This naturally brings us to experimental therapy. Discard the practical aim of experimental therapy, and there will remain a new and fruitful method of studying life, for you will be approaching the life you are studying from a new aspect. . . ."[1]

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[1] I. P. Pavlov, *Complete Works*, Vol. II, pp. 359-60.

At the Thirteenth International Medical Congress in 1900, Pavlov delivered a paper with a very significant title: "Experimental Therapy as a New and Extremely Fruitful Method of Physiological Investigation." In this paper he said: "In its analytical investigations, physiology produces and has produced many changes in the body which lead to sickness or death. Experimental pathology is today reproducing many diseases resembling human diseases. What a wide and fruitful field would be open to physiological research if the experimenter, immediately after calling forth a disease, or in view of an inevitably fatal issue, sought to conquer both the one and the other with full knowledge of how to go about it."[2] To this day these ideas of Pavlov have not been appreciated as they deserve.

BIOCHEMISTRY AND THE PAVLOV PHYSIOLOGY

Not desiring to overburden my report, I cannot dwell at length and in detail on one very important branch of physiology—biochemistry. Everyone, I think, realizes what a big contribution Pavlov made to physiological chemistry at the time when this branch of science was arising in our country. I would remind you of the splendid work he did in collaboration with Nentsky, of the discovery of enterokinase made in his laboratory and of the reversibility of the fermentative processes, and much other work. Soviet biochemistry has made great strides. And there is no doubt that our biochemistry would benefit extremely by working in close contact with the physiologists and pathologists, as was the case at the end of the last and the beginning of the present century, during the time of Pavlov, Nentsky, Danilevsky, Gulevich and Bach.

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[1] I. P. Pavlov, *Complete Works*, Vol. II, p. 354.

[2] *Ibid.*, Vol. I, p. 364.

The majority of our present-day biochemists are working on practical problems of vital importance to medicine and industry. This union of theory and practice will undoubtedly lead to big achievements. In the work of Engelhardt we have a reflection of the idea of the interrelation of form and function. It is necessary in this field to study in the first place the activity of nerve, muscle and glandular tissue from new angles.

Contact with physiologists and the clinic will help biochemists to penetrate more deeply into the laws of the chemical processes which take place in our bodies. Without this union of physiologists and biochemists it will hardly be possible to apply in the spirit of Pavlov's teachings the data obtained in test tubes and retorts to the body processes.

The path chosen by the biochemists who are studying the integration of the various stages of metabolism is highly promising, provided the investigators in this field closely link their researches with Pavlov's ideas in physiology and pathology.

A broad path of research has now been opened to organic chemists in the analysis and synthesis of the various ingredients of the complex chemical substances of the body.

PHYSIOLOGY AND PROPHYLACTIC MEDICINE

Something must be said of the relation of Pavlov's conception of physiology to problems of prophylactic medicine. It is important to discuss the influence Pavlov's physiology has had, and should have, on the principal branch of prophylactic medicine—hygiene, in which I include microbiology.

The science of hygiene studies the external environment, but it differs from other sciences in the fact that it studies the external environment from the standpoint of its influence on the human organism and human communities.

Pavlov and his school, as I have already observed, deal in their investigations with the integral organism.

When people speak of studying the organism as a whole they may mean different things.

According to the old conception which originated with Virchow and which still enjoys credence today, the organism is pictured as a sum of separate units—tissue cells and organs—which all to a certain extent live their individual lives and are connected one with another like the parts of a machine.

The Pavlov school has a different conception of the human organism: the organism is not a machine but a single entity; the organism is not a simple whole but an integral whole.

The *first characteristic* of this conception is that it regards the organism as a single, internally connected entity, as a unity, or, as the term goes, an integration (not a summation), brought about, in the first place, by the combination of tissue cells, organs and fluids into a single complex; in the second place, by the humoral connections; and in the third place, and chiefly, by the nervous system, which links together all the organs, tissues and cells.

The *second characteristic* is the assertion, which is supported by an enormous amount of actual data accumulated in the last two decades, that there is scarcely a function of the body that is not controlled by the higher department of the central nervous system.

The coordinating and regulating activity of the central nervous system determines the *third characteristic* of Pavlov's conception of the organism, namely, that it removes, eliminates, the distinction between the vegetative and the animal life of the organism. Bichat's idealistic conception occasionally makes its influence felt in physiology and hygiene even in our day, hygiene being regarded primarily as the hygiene of the vegetative processes, no account being taken of the coordinating and regulating, and sometimes the predominating, role of the central nervous system.

And the *last characteristic* is the recognition that in the course of the life of the body a definite level of relationships, a specific form of equilibrium, between the external environment and the internal processes is established, organized by the cerebral cortex. These relationships constitute definite dynamic types with different individuals. Disturbance of the established type leads to disturbance of the vital functions. The nature of the type must be taken into consideration in all forms of medical treatment, including hygienic measures—occupational, educational, military and domestic.

Many measures in the domain of food, work and recreation must be based upon Pavlov's conception of types.

The external environment, with which the organisms of living beings form an inseparable unity, was conceived by Pavlov as a single complex.

The environment in which man lives is composed of elements (air, oxygen, radiation, microbes, etc.). Some of these elements are indifferent for the organism, others influence it and cause various alterations in it. Elements of the environment which influence the activity of the body are known in hygiene as environmental factors.

It may be said that Pavlov discovered new environmental factors which before him were entirely unknown or lay in the shadow, outside the field of vision of scientific experimental research.

It was Pavlov who discovered that any element in the external environment which is indifferent for the body may, under certain conditions, become a factor acting upon it through its central nervous system, through its receptors, and that, under these conditions, the action of neutral elements of the external environment may produce profound alterations in the organism.

The numerous experiments of the Pavlov school in this field are well known. For example, a heavy load tied to the back of a dog in the experimental chamber causes a corresponding intensification of metabolism, in the shape of increased absorption of oxygen. In time, the mere sight of the chamber is enough to cause a similar intensification of metabolism in the dog, even when no load is placed on it. When an animal is put in an environment where the temperature is considerably lower or higher than that in which it normally lives, its body usually reacts not to the existing temperature, but to the entire surroundings, which act as a complex conditioned stimulus, in combination with which the temporary connection was elaborated.

Consequently, such neutral elements of the external environment as the sight of the chamber, by exerting an influence through the cerebral cortex, cause an intensification of the oxydation processes in the tissues.

These are the conditioned reflexes discovered by Pavlov, which from the standpoint of hygiene may be regarded as new environmental factors. Pavlov's conceptions are of practical value for hygiene in helping to create proper surroundings in the workplace and the home.

PHYSIOLOGY AND SPA THERAPY

In the organization of rest and recuperation, physiotherapy and spa therapy are very important factors, but hitherto they have been considered in isolation from present-day problems of physiology and pathology.

This isolation is due to the fact that experimental study of spa therapy has been confined exclusively to the special practical problems of this branch of therapy, whereas general physiology, and with it pathology, has from the time of Sechenov to our day concerned itself with the study not only of particular but also, and chiefly, of the general laws underlying the various functions of the body considered as a single entity.

An erroneous conception of the influence of environment on the organism has prevented a detailed study and scientific synthesis of the data obtained by various investigators. An exception to this general rule is the work being done at the Balneological Institute in Pyatigorsk and at the Mineralniye Vody health resorts in the Caucasus. Such investigations were at one time conducted in the Pavlov Laboratory and in contact with Pavlov, but this scientific institution is now in a state of decline.

The Central Institute of Spa Therapy in Moscow has not coped with its principal task—that of conducting research in line with the present-day problems of physiology and pathology. These shortcomings in the organization of experimental research are the chief reason why practical spa therapy is still to a very large extent under the sway of crude empiricism.

Confining itself to particular problems, it has continuously narrowed the boundaries of its investigations and is now at an impasse. Nor have we yet a general theory of the influence of health resort factors on the human organism. Experimental research must have its place in the system of health resort treatment and elevate practical spa therapy to the level of the advanced departments of medical science.

PHYSIOLOGY AND PHYSICAL CULTURE

Physical culture, as a powerful factor in the maintenance of health and working capacity, is closely allied in its aims and purposes with spa therapy and climatotherapy.

The importance of man's muscular activity in the development of his mental activity was already pointed out by Sechenov. Indeed, without muscular movements it would be impossible for man to cognize nature, still less to refashion her by his labour, or to perfect himself by education.

Research in the physiology of work and physical exercise must be specifically directed to the study of man's muscular activity. In this field a further broad development of

Pavlov's teachings is particularly needed. It is necessary to elucidate the specific features of cortical regulation of the functions of the body in the various forms of human activity.

Let us recall what Pavlov said in his famous letter to the miners: "All my life I have been fond both of mental and manual work; I would even say that I am fonder of the latter than the former. And my satisfaction was all the greater when I introduced some smart idea into manual work, that is, combined the work of the head with the work of the hands."[1]

However, the present state of the physiology of muscular activity in general and of the physiology of physical exercise in particular leaves much to be desired. Systematic work on questions of physical culture and sport is being done only in a few laboratories, and their scientific output is moreover relatively small. They are all engaged almost exclusively in the study of record working capacity and completely lose sight of all the other hygienic and educative aims of the mass physical culture movement.

Only one of these laboratories has begun of late to study the activity of the central nervous system during exercise.

A. N. Krestovnikov has amassed considerable data on the influence of physical exercise on various systems of the body. He has also attempted a theoretical explanation of the effect of exercise from the standpoint of Pavlov's teachings.

But his interpretation of human activity is based on experimental data obtained with dogs. This may have been of definite interest at one time, but it cannot be regarded as satisfactory today.

It must be stated that notable results can scarcely be achieved by this method. The creation of artificial experimental conditions, or experimentation only on animals, cannot reflect all the great variety of higher forms of regulation of functions and their development in the natural conditions of human life.

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[1] I. P. Pavlov, *Complete Works*, Vol. I, p. 31.

The physiological changes that take place in the organism of a runner when he crouches for the start result from conditioned cortical impulses. Analysis of this state would therefore enable us to elucidate the peculiarities of cortical regulation of functions in different individuals, and under differing conditions, when they are about to begin physical exercises of different kinds.

This has also a more general theoretical significance. It opens up prospects for an objective study of the emotions which arise, and as they arise, in connection with muscular activity. Study of the activity of the skeletal musculature is likewise of great interest in relation to the receptors of the muscles. The role of the muscles in the cognition of the external world is immense. Sechenov very graphically called the muscular receptors "tentacles," and showed what a big part muscular work plays in cerebral activity. Pavlov's method would help us to penetrate deeply into this extremely interesting and important branch of physiology, which in addition to its value for theoretical knowledge is of great practical value.

Pavlov's teachings cannot be applied to the theory of physical training unless an appropriate laboratory is founded which will work in close connection with practical physical culture and sport.

Proper organizational measures are no less necessary in physical culture therapy and medical control of physical culture. The prophylactic and therapeutic action of exercise has not as yet attracted the attention of medical research institutions.

It seems to me that the Academy of Pedagogical Sciences should interest itself in these important questions, which are of such great significance not only for physical but also for mental development.

PAVLOV'S THEORY OF THE HIGHER NERVOUS ACTIVITY AND PROBLEMS OF ECOLOGICAL PHYSIOLOGY

Pavlov's teachings have a very profound bearing on the general biological problems of the evolution of the physiological functions. Our distinguished biologists have long been aware of this and have utilized Pavlov's ideas and projects in their work.

In the course of our study of the general functions of the cerebral cortex it occurred to us to elucidate also certain general biological laws.

The modern conception of the regulation of metabolism in the animal and human body arose in the latter half of the nineteenth century, when advances in physics and chemistry made it possible to establish that the fundamental laws of conservation of matter and energy are applicable to living beings.

A big part in elaborating the theory of metabolism was played by Russian investigators in the latter half of the nineteenth century—Sechenov, Danilevsky, Pashutin, Likhachov and others. Their researches, which sometimes went parallel with and sometimes in advance of the major investigations abroad, were subsequently taken as a starting point by the American authors Atwater and Benedict, as well as by a large group of present-day investigators. Rubner's conception, which has virtually been accepted as fundamental in all handbooks of physiology, is chiefly based on a comparison of the anatomical features of an animal and the energetic processes in its body, and disregards the higher regulating functions. Such fundamental laws of regulation of metabolism as the so-called law of the body surface and the law of compensation formulated by Rubner, the theory of efficiency, etc., are based upon these energetical concepts, which were an achievement of natural science in the last century, but by no means satisfy our conception of the organism and its historical development.

Investigations undertaken to ascertain whether the higher parts of the central nervous system have any influence on rate of metabolism in the body have not only established that such influence does exist, but have also opened up entirely new paths and vistas for the study of the metabolism of the body under the most diverse conditions of existence.

Facts obtained under different experimental conditions convincingly show that the rate of metabolism, which essentially reflects the general vital activity of the body, depends not only upon inborn reflex activity, but also upon an intricate system of conditioned reflexes acquired in the course of the life of the individual. Extension of these researches induced us to leave the laboratory for a time and to turn to a study of the phenomena which take place in animals under natural conditions.

The normal regime in which the organism functions—the variations of temperature and light in the environment, the influences of changes of working conditions in man's environment, etc.—all these become signals for various changes in the general vital activity of the organism. The diversity of animals studied and the congruity of the results invariably obtained with them definitely convinced us that here we have an extremely widespread law of general biology, one of immense importance in the adaptation of the organism to its surroundings.

Pavlov's celebrated experiments with sham feeding were applied in the investigation of the influence of the act of eating on metabolism. It was discovered that the act of eating is itself a signal which modifies the entire course of energy transformation in the body, as well as the qualitative character of the metabolic processes. Stimulation of metabolic processes by the act of eating does not proceed parallel with the work of the digestive tract but represents a different phenomenon, connected with the formation of temporary reflexes. We also succeeded in elucidating the paths by which these influences are transmitted.

Cortical signals are of no less importance for energy consumption during muscular activity. This constitutes an entirely separate subject of research in the field of the physiology of work, and especially the physiology of physical training and sport.

The vast data on thermal regulation in mammals of various species accumulated at climatic stations has made it possible to elucidate the general laws governing the variations in this function in animals depending on their geographical distribution and mode of life. It has been shown that certain features of the physiological reactions peculiar to a given species appear very late in the development of the individual, and that they largely depend on the activity of the higher departments of the central nervous system.

One practical result of this work has been the attempt to introduce Pavlov's method of investigation into ecological research.

It is our belief that the laws of cortical regulation are highly important for the study of the evolution of the entire reflex activity of organisms.

The very existence of individually acquired regulations of metabolism and other physiological functions furnishes ground for assuming that there are complex reflex conditions in which the relation between unconditioned and conditioned reflexes changes in the course of the evolution of the given species. The basic reflexes, such as the food, defence, orientation, sexual and others described by Pavlov, are constantly undergoing diverse transformations that assure equilibrium between the organism and its environment.

It was to be assumed that the fact that animals are constantly out in the field, searching for food, intensively exercising their muscles, etc., should lead to the formation of new reflexes to their environment, arising on the basis of other reflexes but at a certain stage acquiring a fully independent significance. This assumption has proved to be actually true.

That certain reflexes can be transformed into others with changes in external conditions (type of food, for example) has been demonstrated in the case of naturally conditioned food (salivary) reflexes in beasts of prey and monkeys. It has been shown that the salivary reaction is not evoked by the sight of food, but is inseparably connected with the manner in which the given animal secures its food. The sight of food does not excite salivary secretion in beasts of prey; it inhibits it, due to the fact that these animals must hunt for their food and follow their prey for a long time.

The facts show beyond a doubt that the evolution of the unconditioned reflexes is inseparably connected with the evolution of the conditioned reflexes which continually arise in the process of the animal's adaptation to its conditions of existence. An abundant variety of data points to the exceptional importance of the theory of cortical regulation for the development of Soviet creative Darwinism.

I thought it necessary to dwell at such length on the data obtained on the regulation of metabolism and associated phenomena, because they bring us directly to problems of great practical importance, and open broad prospects for work in highly important fields of biology.

It must be stated that the work done in this direction both in experimental and practical physiology and biology has been very limited. Deserving of special mention are the very important beginnings made in this field by D. A. Biryukov.

PHYSIOLOGY AND CLINICAL MEDICINE

"In their deep sense, physiology and medicine are inseparable," Pavlov once wrote. And it is particularly important and timely just now to dwell on the direct application of Pavlov's ideas, aspirations and plans to practical medicine.

On this aspect of Pavlov's work much has been said and written in the periodical press and at conferences and congresses, pointing out the immense value of Pavlov's teachings to practical medicine.

Actually speaking, Pavlov's teachings on the activity of the animal organism constitute the basis of modern scientific medicine.

There is no branch of medicine where Pavlov's view of the activity of the animal organism and, specifically, of the human organism, does not play a primary role. It may be said without exaggeration that, beginning with the minor and special medical subjects and ending with the broad fields of therapy, surgery and psychoneurology, Pavlov's physiology has exercised an enormous influence and created all the premises for a fresh advancement of medical science.

In these past decades a new trend in medicine has arisen in the West and in America, known as "psychosomatic medicine." This is a pale and deformed reflection of the trend which in our country was founded long ago by eminent clinicists and known as "nervism," that is, the idea that all processes in the organism are subordinated to the nervous organization, both in the normal and disturbed state of the vital functions.

Like every other science, "psychosomatic medicine" is based upon a definite philosophical foundation, which is a reflection of definite social and class relations in society. And depending upon this philosophical foundation, any given science develops either along the path of true science or along the path of pseudo science. The aim of the latter in class society is to protect the interests of the doomed class, to fulfil its social orders, and thereby "fence itself off from the people."

Abroad, especially in America, where the expansionist tendencies of monopoly capital are manifested in their most brazen form, "psychosomatic medicine" is forced to arm itself with the most reactionary theories in order to defend the interests of the ruling classes. The mouthpiece of these reactionary theories in America is the journal

Psychosomatic Medicine, as well as a number of monographs.

The basic theoretical thesis of foreign "psychosomatic medicine" is that man is governed by instincts, by pugnacious and aggressive impulses, which in civilized society are to a large degree repressed. Repression still further intensifies the instincts. "This vicious circle," we are told in the afore-mentioned journal, "is one of the best known mechanisms revealed by psychoanalytic study of neurotic personalities."

Neuroses thus arise from man's "vile instincts" and from "civilization," which represses these instincts. It should be stressed that both man and "civilization" are regarded in isolation from the class structure of bourgeois society. A long article on hypertension by devotees of this reactionary science concludes with the statement that "in this realm psychiatrists should play a leading role, because it is to them that we must turn for our knowledge of the analysis of modern civilization, in which the hypertensive state seems to flourish." The adverse influence of civilization in causing hypertension is postulated by these same authors in the following manner: "In the aboriginal native protected against social struggle by collective emotional regulations, taboos, and ceremonies, the incidence of hypertension appears to be low. On the other hand, in the urban American Negro, who has been removed for several generations from his protective aboriginal society and placed in the civilization of the West, the incidence is high." It is characteristic that the authors do not say a word about the incredible exploitation of, and inhuman discrimination against Negroes in the "democratic" United States, where this regime creates absolutely intolerable conditions of existence for Negroes. This the afore-mentioned authors do not see.

Other authors, when comparing the incidence of hypertension among African and American Negroes, do not disclose the nature of the class struggle in modern bourgeois society, but confine themselves to asserting that "the difficulty of adjusting to the complex conditions of the cultural life is the essence of psychoneuroses."

Lack of time prevents me from quoting many other absurd and reactionary pronouncements of the "learned" American psychosomatists.

In the past few years, in connection with the growth of reaction, especially in America and England, medicine has been actively reviving Freudism and taking its threadbare dogmas as its basis.

Dr. F. Alexander, a "prominent" scientific worker at the Chicago Psychoanalytical Institute, and a member of the staff of the afore-mentioned journal, says, for instance, that "Freud's influence upon our present age cannot be evaluated by focussing attention upon the medical implications of his teachings alone.... All the social sciences are receiving a new stimulation from his dynamic psychology."

It therefore behoves us in our journals and monographs to concentrate the fire of criticism primarily on those postulates of the Freudian doctrine which are being refurbished and utilized by medicine abroad.

At one time the opinion was expressed that attempts had been made here in the Soviet Union to combine Freudism with Pavlov's theory of the conditioned reflexes into a single system of "reflexological Freudism."

It must be said to the honour of our Soviet physiology that there have been practically no attempts to create a "reflexological Freudism." Pavlov himself disassociated himself from Freud on many occasions, and sharply criticized his conceptions. Speaking in a letter to the well-known French psychiatrist Pierre Janet of the legitimacy of the physiological approach to the explanation of psychopathological phenomena, Pavlov said: "While utilizing facts which you yourself have established and systematized, I venture to take a different path and to apply a physiological explanation." Pavlov was here referring to the pathogenesis of neuroses.

The Freudian conception is alien to Pavlov's disciples and followers, because of its unscientific character.

The problem of the interaction and interpenetration of the mental and physiological is one which has been studied throughout the whole history of Russian medicine. Already at the dawn of the nineteenth century, M. Mudrov, the Russian clinicist and educationalist, devoted a great deal of attention to the interaction between the mind and the body. Sechenov, Botkin, Pirogov, Ostroumov and other eminent Russian physicians and scientists always stressed the role of the mental factor in the genesis of disease. Pavlov's theoretical views on the cortico-visceral laws which are now being applied by Soviet scientists, have found concrete realization in the study of a number of problems of great moment to the theory and practice of clinical medicine.

At two conferences on cortico-visceral pathology held in recent years concrete examples were presented convincingly demonstrating what a powerful role the cerebral cortex plays in the origin and development of pathological processes.

Reports along these lines were presented on clinical investigations of peptic ulcer and hypertension, and on the pathogenesis of neuroses, and, in connection with this, methods were indicated of therapeutically influencing the cortex, and through it the whole course of diseases. Protective inhibition, shock therapy, hypnosis and other problems were also discussed at these conferences.

This new departure in our medical science signifies a transition from a simplified and limited conception of disease to a new view of the nature of the human organism, which regards it as a living individual entity, whose development and activity are determined by the specific conditions of its social environment.

The humanism of Russian medicine still remains its most splendid attribute, its badge and banner.

The Pavlov physiology and materialist psychology regard "soul" and body in their dialectical unity. This is our firm and unshakable foundation, in contradistinction to the baseless, unsound, almost medieval Anglo-American bourgeois conception of human physiology and pathology.

Until quite recently the role of mental and emotional factors was mentioned only casually; and that only in connection with such diseases as goitre, diabetes and neuroses of various organs. Thus, internal medicine ignored the wide field of pathogenetic factors, which really exist. Experimenters shut themselves up in the four walls of their laboratories and could not see the light of truth emanating from life itself. Only now can we speak of the universal significance of the nervous system, and particularly of its highest formation—the cerebral cortex—in the majority of human diseases.

In order to answer the urgent questions posed by our advanced medicine, general pathology must, of course, supplement the traditional method of vivisection with a study of human physiology in the clinic, by observation and by the method of the chronic experiment devised by Pavlov. Only then will it approach a solution of the most vital and important problems of human pathology.

We are coming to realize ever more clearly that the pathogenesis of disease is no less complicated than the body itself in which the disease occurs, that we have an oversimplified view of the complicated process that leads to disease, that emotional influences may often be far stronger than any physical factor, that a spoken word may cause profound changes in the entire organism.

The oversimplified conception of disease as a local lesion was a product of mechanistic materialism, of "cheap" materialism, as Engels called it, and was far removed from the methodology of dialectical materialism.

As against the elementary, oversimplified conception of disease, which regarded it as a chance episode of exogenic origin, we now consider disease in relation to all the preceding physiological factors, not only of the somatic but also of the mental life of the human being. Ontogenesis, the whole preceding life of the organism, cannot be ignored when determining the pathogenesis of a disease.

As early as 1876, V. A. Manassein, in his remarkable monograph which long anticipated modern "psychosomatic medicine" ("Data on the Etiological and Therapeutical Significance of Mental Influences"), expressed some profound thoughts on the influence of man's mental activity on his health, and on the part played by mental shocks and emotions in the origin of systemic diseases, including tuberculosis.

In the interest of historical truth, it should be pointed out that already in 1911 (that is, prior to the German Professor Bergman) P. S. Ussov, who died so prematurely, drew attention to the significance of primary functional neurogenic influences in the origin of organic diseases. "A protracted neurosis (neurotic disease)," he wrote, "may fatally lead to an anatomical change in the intestines.... There is a whole chain of functional diseases of the intestines the first links of which border on psychiatry...."[1]

I might cite statements of our present-day clinicists on the interpretation of the pathogenesis of all manner of human diseases. Our progressive scientists are on the correct road to an understanding of the activity of the human organism, the road which was mapped out for us by a galaxy of Russian medical scientists.

Authors abroad (American, British, French) display utter helplessness in their attempts to explain the psychogenesis of somatic diseases. They ignore Pavlov's teachings, deny the physiological basis of mental activity, and indulge in hollow idealistic and speculative theorizations and conjectures. Their psychoanalytical Freudian way is not our way, the more so that the trend of the majority of the American psychosomatologists is, in the final analysis, rooted in mystical conceptions, which reflect the decay of bourgeois society, its descent into fascism.

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[1] P. S. Ussov, "On Neuroses of the Intestines," *The Medical Practitioner*, 1911.

We are persistently striving to elucidate the physiological and pathological mechanisms and structure of the cortico-visceral relations on the basis of the broad and profound conception of the founder of modern Soviet scientific medicine.

We are discarding localistic tendencies and are approaching a synthetic and integral conception of the body as a whole and its dynamics. Instead of the American term "psychosomatics," which stresses the dualistic view, it would be more correct from the medical aspect to designate this field as cortico-visceral pathology. This problem is not only of theoretical and fundamental significance, it is also of great practical importance. The established dependence of systemic diseases on the central nervous system calls for treatment of these diseases based on their pathogenesis, namely, for the necessity of influencing the course of systemic diseases through the central nervous system. This is an essential corrective to the former narrow localistic trends in therapy, which treated only the local pathological process.

The static Virchowian schemes were unable to reflect all the vivid and multiform manifestations of human life. The result was that the leading branch of medicine—general pathology—did not rise to man's level, but rather degraded man to the level of the animals, who do not possess man's cerebral cortex, his social attributes, speech, the higher emotions. The etiological factors of disease were likewise oversimplified, while the peculiarities of the environment in which man lives were simply ignored.

After he had established the basic laws of the physiology of the higher nervous activity in animals, Pavlov repeatedly pointed out that the data obtained with animals cannot be mechanically transferred to man.

The pinnacle of his creative daring in disclosing the material nature of man's mental activity was the idea that, in addition to the signal system which man possesses in common with the animals, he also possesses another, a special signal system specific only to the human being.

"If our sensations and ideas relative to the surrounding world," Pavlov said, "are for us the first signals of reality, concrete signals, then speech, especially and primarily the kinesthetic stimuli which proceed from the speech organs to the cortex, constitutes a second set of signals, the signals of signals. They represent an abstraction from reality and permit the forming of generalizations, which constitute our extra, *specifically human, higher mentality*. . . ."[1]

In this, the most difficult problem of natural science, too, Pavlov the materialist remained true to himself. For man, Pavlov says, speech is "as much a real conditioned stimulus as are all the others which he shares with the animals, but at the same time it is more comprehensive than any other, in this respect being above all comparison, quantitatively and qualitatively, with the conditioned stimuli of the animals."[2]

It must be regretfully stated that exceedingly little is being done by us in the Soviet Union to develop Pavlov's remarkable idea of the second signal system. A large part of the responsibility for this lies with the Academy of Pedagogical Sciences, which with its research institutes and splendid child material is in a better position than any to develop this department of Pavlov's teachings.

As to the clinic, it must develop a genuine human physiology, and that is the foundation of scientific medicine.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 490.

[2] *Ibid.*, Vol. IV, p. 337.

In stressing the role of the central nervous system in the origin of many diseases, we cannot, of course, confine ourselves to the customary vague talk about "nervous causes" or "anthropology," or to merely subjective psychoanalytical conjectures. Our task must be to elucidate the functional structure and the mechanism of mental influences of the cerebral disturbances which cause systemic diseases. We must tackle this complex problem with exact data on the visceral functions of the different parts of the brain, on the interrelations of the cortex and the subcortical regions, and on the laws discovered in evolutionary physiology, as well as with the data furnished by the clinic with respect to both internal and nervous and mental diseases.

CONCLUSION

All that has been said, I think, once more confirms that the great Stalin epoch is the epoch of the building of a new, communist society in which man for the first time becomes a truly free personality with unlimited opportunity to arrange his life in the best possible way. This gives rise to a new attitude towards the study of the human organism, with the aim of maintaining it in a state of vigour and health.

This is the determining factor not of some particular problem or task, but of our whole scientific outlook in physiology. The aim must therefore be to bring about a radical change of attitude towards Pavlov's teachings in all fields of theory and practice, and a full recognition of the fact that his classical discoveries are of fundamental and universal significance in all branches of physiology and medicine. Research in development of his theories must be conducted strictly along the lines of the problems which he himself posed or which follow from the substance of his teachings. What is needed is a creative elaboration of all the ideas Pavlov bequeathed. We must cast dogma aside and move forward. "Only by passing through the fire of experiment," Pavlov wrote, "will medicine as a whole become what it should be, namely, a conscious and, hence, purposefully acting science."[1]

I trust that those I have mentioned in this report will have understood me correctly. I have a deep esteem for all our physiologists and biologists; but it must always be borne in mind that service of the people stands above all else. In the face of the great tasks of science, all personal considerations must recede into the background.

"Science is becoming the nervous system of our planet," Maxim Gorky once said, and the realities surrounding us are a striking confirmation of these words. The great minds of our day are creating a marvellous new world on the basis of science. The theory of Marx-Engels-Lenin-Stalin is being fully reflected in practical life. The opportunities for the promotion of our science and of man's creative activity have never been so favourable and so vast as in our Socialist State.

Towards the end of his life Ivan Petrovich Pavlov reminded us again and again that our country placed great hopes in us, that much had been given us, but that much also was demanded of us.

To serve our people and multiply their cultural forces is the supreme duty we owe to the new communist society that is coming.

It is the obligation of the older generation to pass on its experience and knowledge to the younger. The great aim confronts us of educating the future workers in the new, advanced biology and medicine. It is my opinion that the system of teaching biologists and physicians in our universities must be radically changed. This is a serious matter which must receive our earnest thought. Much of that which has to be done is already clear.

In his article *Concerning Marxism in Linguistics*, the great Stalin made it abundantly clear how important wide and free discussion is for the advancement of the new and progressive in science. "It is generally recognized," he said, "that no science can develop and flourish without a battle of opinions, without freedom of criticism."[1]

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[1] I. P. Pavlov, *Complete Works*, Vol. II, p. 360.

We must open up new paths in physiology. It will be a long and tremendous work, but it may be taken for granted that, with the aid of the Party and the Government, we shall avail ourselves of every opportunity to give a new impetus to science for the benefit of the people.

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[1] J. Stalin, *Concerning Marxism in Linguistics*, Pravda Publishing House, 1950, p. 28.

LINES OF DEVELOPMENT OF I. P. PAVLOV'S IDEAS IN THE PATHOPHYSIOLOGY OF THE HIGHER NERVOUS ACTIVITY

REPORT

BY PROFESSOR A. G. IVANOV-SMOLENSKY

Because of the place it holds in science, I. P. Pavlov's theory of the higher nervous activity constitutes, as it were, the most effective link between biology—above all creative Soviet biology—and Soviet medicine.

As far back as 1903, Pavlov formulated the new task of research confronting him in the following words: "I venture to think that what I am about to communicate will convince you, as I am convinced, that here there opens before us an infinite domain for fruitful research, a second immense part of the physiology of the nervous system—a system which primarily establishes the relation not between the individual parts of the organism, with which we have been mainly concerned hitherto, but between the organism and its surroundings."[1]

Already in the basic concepts of the theory of the higher nervous activity—in the concepts of conditioned and unconditioned connections—we find expressed with an amazing depth of synthesis and with extreme brevity and terseness all the major biological problems: the theory of evolution, the interaction between the organism and its environment, adaptability and variability, heredity and acquired experience, ontogenetic and philogenetic development and, lastly, the inheritance of acquired characters.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 28.

According to Pavlov, as we know, the development, the evolution of the nervous activity is effected entirely through unconditioned and conditioned connections.

An unconditioned connection is a relatively constant, inherited connection between an organism and its environment, formed in the course of philogenesis; a conditioned connection is a temporary and highly variable connection between the environment and the organism, acquired in the course of ontogenesis. Conditioned connections, if repeated through a series of generations, may be "converted hereditarily into unconditioned connections." The cerebral cortex of the higher animals, according to Pavlov, possesses a coupling, or linking, function, that is, the function of acquiring, forming, creating new connections between the organism and its environment, the function of evolving new vital experience, the function of ontogenetic adaptation, which adjusts the organism to the conditions of its environment, and the environment to the requirements of the organism. It should be stressed that this all-important function of the animal organism first became known to science and an object of experimental research thanks to I. P. Pavlov.

Stating repeatedly that his scientific investigations embraced the activity of the organism as an integral whole, Pavlov understood this integrity in three senses.

First, the organism is an integral whole because all its parts and their functions are interconnected, because it is a system which functions as a single whole, a system, moreover, which is constantly and continuously interacting with its external environment in a process of mobile, fluent, ceaselessly fluctuating and unstable equilibrium between the organism and the surrounding world.

"The theory of reflexes," Pavlov says, "is now, as it has indeed been ever since its inception, constantly and continuously enlarging the number of phenomena in the organism which are connected with the conditions that determine them, that is, it is increasingly explaining the integral activity of the organism."[1]

Secondly, the organism is an integral whole because of the functional unity, achieved mainly through the nervous system, between its external and internal vital activity, that is, between the activity which connects the organism with the conditions of its external environment and the activity going on within its internal environment.

"The function of connecting both the internal and external relations of the organism is performed by the nervous system,"[2] Pavlov says.

Thirdly, and lastly, the organism is an integral whole because of the unity of the mental and the somatic.

"... If we are to have a truly scientific understanding of our neuropathological symptoms and be able to treat them successfully," Pavlov said in one of his last scientific writings, "we must get rid of the habit so deeply ingrained in us of drawing a line between the mental and the somatic."[3]

But it is noteworthy that in his endeavour to study the organism as a whole, Pavlov never gave preference only to synthetic, or, on the contrary, only to analytical activity, and said that "any attempt to draw a line between these activities, to give preference to one over the other, cannot lead to sure success. ..."[4]

Nor was his method of investigation at any time solely analytical or solely synthetic, but always combined the one and the other, and this we find most strikingly reflected in his theory of the higher nervous activity.

And one last remarkable and, moreover, highly characteristic feature of all Pavlov's physiological, and also pathophysiological, investigations was his endeavour not only to study, but to govern the phenomena under study, to direct and command them, to change them in the desired direction.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 437.

[2] *Ibid.*

[3] *Ibid.*, p. 581.

[4] I. P. Pavlov, *Physiology and Pathology of the Higher Nervous Activity*, Gosmedizdat, 1930, p. 36.

From this derives the close connection between Pavlov's physiological and pathophysiological investigations, on the one hand, and experimental therapy, on the other, which we find vividly reflected in the substance and even the name of a lecture he delivered as long as fifty years ago, in 1900, entitled: "Experimental Therapy as a New and Extremely Fruitful Method of Physiological Investigation."[1]

Hence Pavlov inseparably associated the study of the functions of the animal organism with the task of governing them, and, in particular, with the task of restoring impaired functions.

I say all this in order to remind you that Pavlov's investigations, while they were based on a broad biological foundation and were imbued with the theory of evolution, at the same time had a bearing on major biological problems.

Nor is it difficult to discern that, as regards the determining role of the external environment in the adaptive activity of the nervous system, the transformation of conditioned, i.e., acquired, reflexes into unconditioned, inborn reflexes, and the inseparable connection between the study and the mastery, the governing, of physiological functions, Pavlov's teachings have close points of contact with our creative Michurinian biology.

I shall now pass to the connection between Pavlov's teachings and medicine.

But before dwelling briefly on the three main stages in the development of Pavlov's scientific activity illustrative of this connection, I want to draw your attention to a statement he made as early as 1906 in which his views on this subject are brought out v ry distinctly.

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[1] I. P. Pavlov, *Complete Works,* Vol. I, p. 355.

"In their deep sense," he said, "physiology and medicine are inseparable. If the physician is actually, and still more in ideal, an engineer of the human organism, then inevitably every new physiological discovery must sooner or later increase the physician's power over this extraordinary mechanism, his power to conserve and repair it."[1]

From these words it is clear that Pavlov considered that the chief task of physiology was, by studying the laws of the course, disturbance and restoration of the physiological processes, to equip medicine with means for the elaboration of scientifically grounded prophylactic and therapeutic measures.

In the speech he delivered in 1899 in memory of Botkin, Pavlov said: "The final triumph of medicine will come only through laboratory experiment."

We know that in the first, the earliest, period of his scientific activity, which was mainly devoted to the physiology of the blood circulation, Pavlov worked in the clinic of S. P. Botkin, Russia's great clinicist, who considerably influenced the formation of the young Pavlov's views on the connection between laboratory and clinical research and the trend of his scientific work generally.

Already in this period Pavlov's interest in the nervous regulation of physiological processes is clearly to be observed —at that stage, in the nervous regulation of the blood circulation and, in particular, of cardiac activity. The importance of Pavlov's experimental researches in this field for clinical practice, their originality and novelty, the ingeniousness of the methods he used, were highly appreciated by Botkin, and have been similarly appreciated by clinicists right down to our day.

It was in this period that, in the course of his researches into the blood circulation, Pavlov evolved the principle of "extending the influence of the nervous system to the largest possible number of the organism's activities," which found expression in many different ways in all the succeeding stages of his scientific work, attaining its most vivid and perfect embodiment in the theory of the higher nervous activity.

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[1] *Ibid.*, Vol. III, p. 70.

In 1883, in the concluding section of his M. D. thesis on the centrifugal cardiac nerves, Pavlov wrote: "... I was surrounded by the clinical ideas of Professor Botkin—and I acknowledge with heartfelt gratitude the fruitful influence on this work, and on my physiological views in general, of that profound and broad theory of 'nervism,' one that has often anticipated experimental data, which, in my opinion, is Sergei Petrovich Botkin's chief contribution to physiology."[1]

With Pavlov, the physiology of the blood circulation was inseparably connected with pathology. His work in this field has been continued by Smirnov, Razenkov, Bykov and other of his disciples.

The connection between Pavlov's scientific investigations and medicine was revealed even more clearly, definitely and distinctly in the second period of his creative activity, which was devoted to a study of the physiology of digestion, and which was reflected in his celebrated *Lectures on the Work of the Principal Digestive Glands,* a work that Pavlov completed in 1897.

Essentially, this significant department of physiology was founded by Pavlov, and his broad and brilliantly novel theoretical generalizations in this field were combined with conclusions of practical importance to medical science. At the same time, the absolutely original method of research Pavlov elaborated marked an epoch in the development of what may be called "surgical physiology."

But in his study of the physiology of digestion, too, Pavlov's attention was focussed on the mechanisms of the nervous regulation of the processes of digestion, on the innervating apparatuses—in other words, on the further development of the principle of "nervism," now extended to new fields of physiological activity.

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[1] I. P. Pavlov, *Complete Works,* Vol. I, p. 142.

It is noteworthy that the last, the eighth, lecture on the work of the digestive glands, is entirely devoted to the application of the experimental data obtained by Pavlov to problems of practical medicine. The lecture begins with the following words: "The subject of our discourse today will be a comparison of the previously communicated results of laboratory investigation with the habits and customs observed in the partaking of food, and with the measures prescribed by the physician in disorders of the digestive apparatus."[1] With Pavlov, as we see, the problems of the physiology of digestion were also closely connected with problems of pathology. This lecture contains a number of important indications of value to medicine on the subject of diet, hygiene of nutrition and the treatment of various digestive disorders.

Pavlov concluded this lecture, and with it the whole book, with the words: "If the physiological facts communicated here may help the physician to understand certain things in his sphere of activity and contribute to the devising of more correct and effective methods of treatment, the physician will derive further benefit if he brings to the attention of the physiologist in what way, in his opinion, the explanations given here need correction, and also if he points out those new aspects of digestion which he has already discovered in the broad world of clinical observation, but which have not yet come within the field of vision of the physiologist."[2]

It is scarcely necessary to dwell on the great importance of Pavlov's experimental investigations for the clinical treatment of disorders of the digestive organs, investigations which have been continued by Razenkov, Bykov, Volborth and other of his disciples.

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[1] *Ibid.,* Vol. II, p. 133.
[2] *Ibid.,* p. 149.

Today, Pavlov's teachings are of great help to the clinicists in prescribing diet, nutrition regimen and treatment in cases of peptic ulcer. Nevertheless, as Professor Myasnikov has said, "a wide group of disorders of the bowels and of the bile secretion system is practically not treated from the Pavlov standpoint at all." And, therefore, "the important task confronts clinical medicine of filling this gap and re-examining the pathology and therapy of digestive disorders on the basis of Pavlov's ideas."[1]

In an article, "I. P. Pavlov's Teachings and Soviet Medicine," printed in 1949, E. I. Smirnov says: "There are grounds for asserting that we have lost much by not paying proper attention to the broad development of scientific research in the field of experimental pathology, thereby retarding the broad introduction of Pavlov's ideas into medical practice."[2]

Pavlov's investigations in the physiology of the blood circulation and digestion showed that their importance for medicine lies not only in the fact that they help us to understand the mechanism of the origin, i.e., the pathogenesis, of diseases, but that they also indicate the way to treat them, that is, to work out a therapy based upon pathogenesis.

As we know, Pavlov's study of the nervous regulation of the digestive processes drew his attention to the phenomena known as psychological salivary secretion, and at the same time directed him into that new scientific path which led to the theory of conditioned reflexes.

We also know that in the course of his scientific work Pavlov repeatedly touched upon the question of neurotrophic activity, and that he discovered a number of important facts and expressed many a valuable opinion on this subject.

We now pass to the third, concluding and at the same time most important stage in Pavlov's scientific work, during the 35 years of which the unflagging efforts of Pavlov himself and of his numerous disciples resulted in one of the greatest treasures of Russian science, and the most perfect realization of Pavlov's idea of "nervism"—the Theory of the Higher Nervous Activity.

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[1] *Vestnik of the Academy of Medical Sciences,* 1949, No. 6, p. 17.
[2] *Ibid.*, p. 11.

Already in his first scientific work, describing his initial steps along the new path of research, Pavlov speaks of his intention to build an experimental psychology and experimental psychopathology based on a study of animals.

"Of course," he said, "experimental work in psychopathology began when physiologists first removed one or another part of the central nervous system and observed the animals that survived the operations. The last twenty or thirty years have produced some capital facts in this field. . . . But the investigations have not yet developed into a special department that may be studied uninterruptedly and according to a definite plan. The reason for this, it seems to me, is that the investigators still do not possess any considerable, detailed and systematic knowledge of the normal relations of the animal to its surroundings to help them make an objective and exact comparison of the state of the animal before and after operation."[1]

Pavlov wrote this in 1903, when he was proposing to undertake a scientific study of experimental psychology and psychopathology with animals. But the subsequent development of Pavlov's theories far surpassed these initial expectations.

In the succeeding decades Pavlov's school unflaggingly and uninterruptedly pursued the study of the fundamental laws governing the activity of the higher parts of the central nervous system, and created a new department of science—the physiology of higher nervous activity, and also, in close conjunction with this, developed the pathology, or, it would be more correct to say, the pathophysiology, of higher nervous activity. Indeed, the pathology of the higher parts of the nervous system could scarcely have developed except in close conjunction with the physiology of these parts.

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[1] I. P. Pavlov, *Complete Works,* Vol. III, p. 36.

As we know, once having proceeded to an experimental study of the pathology of the higher nervous activity of animals, Pavlov gradually entered the field of clinical medicine, and here he laid the foundations of the clinical pathophysiology of the human brain. It was here, in the clinic, that there arose in his mind the remarkable idea of a first and a second signal system of the cerebral cortex; it was here, in the clinic, that he began his study of the typological features of these systems and the pathological disturbances of their interaction.

We must appreciate to the full that the higher function of the brain which we call mind, consciousness and so on, was for many *thousands of years* studied by men who had no knowledge, not only of the fundamental laws of the nervous processes, but even of the internal structure of the brain, and, naturally, for a very long time it was not even suspected that there was any connection between mental activity and the nervous system.

The basic concepts of psychology (mind, will, feeling, etc.) were evolved in their time exclusively by the descriptive method, without any participation of the morphology and physiology of the brain. The origin of mental activity was shrouded in an impenetrable mist, and this activity was thought to be the manifestation of some deeply mysterious, incomprehensible and enigmatic force (entelechy, soul, life force and so on).

The progress of microscopy in the second half of the nineteenth century, and especially at the end of that century and the beginning of the twentieth, contributed in a very large measure to the development of the normal and pathological morphology of the brain and, in particular, to a study of the most delicate structure of its higher parts. Cyto-architectonic and myelo-architectonic investigation assumed wide scope.

But very different was the situation with regard to the physiology, and, hence, the pathophysiology, of the higher parts of the brain: instead of studying the laws of the course and interaction of the higher nervous processes in physiological and pathological conditions, for a long period persistent attempts were made to base psychological and psychopathological concepts on the anatomical structure of the brain. If I may so put it, efforts were made to superimpose a psychological and pathopsychological pattern on the morphological canvas of the brain.

This is the way the old theory of the localization of mental functions arose, which sought in the brain specific areas for sensations, ideas, memory, association, acts of volition, emotion, etc.

In the same way, attempts were made to localize various psychopathological disturbances in different parts, lobes, and even convolutions and sulci of the brain.

It is quite obvious that this psychomorphological trend had very little in common with a genuine physiology and pathophysiology of the higher parts of the central nervous system.

In the latter half of the last century and in the early part of this, foreign scientists, notably the German psychiatrists Meynert and Wernicke, attempted a complete reconstruction of psychiatry with the help of the psychomorphological trend. The attempt, however, was unsuccessful.

With the further advances of the morphology of the brain in the 1920's and 1930's, renewed attempts were made to reconstruct psychiatry on the basis of a correlation of the psychopathology and pathological anatomy of the brain. Here again it was German psychiatrists who were most active—Kleist and Pötzl, who tried to found what they called a "cerebral pathology" (*Gehirnpathologie*).

If Meynert and Wernicke were unable in their time to call in the aid of the physiology of the higher parts of the brain, because it did not yet exist, the complete ignoring of the physiology and pathophysiology of the higher parts of the central nervous system by the resurrected psychomorphological trend—which, moreover, without adequate warrant appropriated to itself the name "cerebral pathology"—was absolutely unjustified, and can only be explained by the chauvinistic, anti-Russian and anti-Soviet tendencies of the German psychiatrists of that period.

That the achievements of our Russian physiology of the central nervous system—the work of Sechenov, Vvedensky, Ukhtomsky and Samoilov, and especially the physiology and pathophysiology of the higher nervous activity created by I. P. Pavlov and his school—are of immense value to psychiatry is today beyond all question. If the attempts made in the last century to establish direct correlations between psychopathology and the pathological anatomy of the brain were of progressive significance, to return to this path in our day, and to ignore, or to content oneself with a superficial knowledge of only a professed recognition of Pavlov's teachings—as is to be met with occasionally—is a profound and impermissible error.

This so-called "cerebral pathology" trend which emerged from German psychiatry may be evaluated in the words of Andrei Alexandrovich Zhdanov: "One and the same idea may, in different specific historical conditions, be reactionary or progressive."[1] The psychomorphological trend in psychiatry, which ignores, or clearly underrates, or, still more, while pretending to recognize, is hostile towards the modern achievements of our physiology and pathophysiology of the higher parts of the nervous system, cannot claim to be an advanced and progressive trend in Soviet psychiatry. Yet it is no secret to anyone that among our leading psychiatrists there are still some who energetically propagate the ideas of this so-called "cerebral pathology," and who to this day refuse to recognize the importance of Pavlov's physiology and pathophysiology of the higher nervous activity for the further advancement of our psychiatry.

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[1] *Speech in the Discussion of G. F. Alexandrov's Book, June 24, 1947*, Gospolitizdat, 1947, p. 21.

One cannot without bitterness recall that for a long time and even down to quite recently all attempts to apply Pavlov's teachings to psychiatric problems were greeted with hostility, were referred to contemptuously as "empty prating," and were regarded as a "grave mechanistic menace" to Soviet psychiatry. At the same time, Pavlov's ideas were opposed, now by this celebrated "cerebral pathology" (Shmarian), now by a so-called "dynamic physiological conception," supposedly created, according to Professor Shmarian, by the joint efforts of several leading Moscow and Leningrad psychiatrists and destined to reform psychiatry, now by the "theory of integration, disintegration, reintegration and pathological integration," of which the English physiologist Sherrington and the Moscow psychiatrist Professor Gurevich are to be regarded as the founders.

Unfortunately, trends like these have not been eliminated from our psychiatry to this day.

Monographs which have appeared in recent years on old and new problems of psychiatry, or on more particular problems, such as mental disorders in cases of brain tumours, as well as new textbooks of psychiatry, do not reveal that their authors, although they profess to recognize Pavlov's teachings, have seriously mastered even a general knowledge of the physiology and pathophysiology of the higher nervous activity. They teem with the grossest errors in this respect, and bear witness that their authors have only a most superficial acquaintance with Pavlov's theories.

Psychiatry and to some extent, unfortunately, neuropathology continue stubbornly to adhere to the old psychomorphological line, and at the same time to the old theory of the localization of mental functions.

Yet the brilliant work of I. M. Sechenov had already laid a theoretical foundation for the physiology of the higher parts of the brain; and in the present century, thanks to the genius of I. P. Pavlov and to the work of the great physiologist and his numerous disciples and collaborators, a real physiology of the cerebral hemispheres was at last founded—a physiology, and with it a pathophysiology, of the higher nervous activity. This opened up the possibility, created the premises for, the erection of a new theory of the localization of functions in the brain.

The tremendous importance of the discoveries of I. M. Sechenov and, especially, of I. P. Pavlov for natural science, is brought home with extraordinary clarity in the words the latter uttered at the Twelfth Congress of Scientists and Physicians in Moscow, on December 28, 1909: "It may be said with truth that the irresistible onmarch of natural science since the time of *Galileo* made its first noticeable halt before the study of the higher parts of the brain, or, more generally, the organ of the most complicated relations of the animal to the external world. And it would seem that this is not without reason, that this really is a crucial point in natural science, since the brain, which in its highest form —the human brain—created and creates natural science, here itself becomes an object of natural science."[1]

In his 35 years of strictly objective investigation of the higher nervous activity, Pavlov brilliantly mastered this "crucial point of natural science"; and in this he was to a large extent assisted by the new conditions for scientific work which were made available to Pavlov by our Government and Party, first by Vladimir Ilyich Lenin and later by Joseph Vissarionovich Stalin.

Already in 1921, a special resolution of the Council of People's Commissars, signed by Lenin, recognized "the quite exclusive scientific services of Academician I. P. Pavlov, and their immense importance to the working people of the whole world."

The higher functions of the brain which we call mental activity, and which for thousands of years were the object of study by psychology, and later also became the subject of investigation by physiology, or, more exactly, the psychophysiology of the sense organs, and by the old theory of the localization of psychical functions, was now subjected to systematic study by a new branch of science—the physiology of the higher parts of the central nervous system.

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[1] I. P. Pavlov, *Complete Works,* Vol. III, p. 95.

The higher nervous processes, which form the basis of the phenomena described by psychology, the basis of psychological concepts—processes which until recently were entirely unamenable to study, now became the subject of objective investigation by a new science, the science founded by I. M. Sechenov and built up by I. P. Pavlov and his school.

And, at the same time, access was opened to those pathological changes in the higher nervous processes which underlie the disturbances described by the psychopathologists, which constitute the pathophysiological basis of neuropsychic diseases. The hope arose that ways would be found for a new, scientifically founded treatment of these maladies, which not infrequently are very severe.

However, the new ideas of Sechenov and Pavlov regarding the origin and neuro-dynamic foundation of the mental processes were bound to collide and come into conflict with, to give battle to, the old-established and obsolete notions about the nature and origin of mental activity which were inseparably connected with the principles of the idealist outlook, of the idealist philosophy which predominated at that time. As we know, these notions, which dated back thousands of years, not only dominated psychology, but were shared by many natural scientists of the time.

In his paper, "Scientific Investigation of the So-Called Mental Processes in the Higher Animals," Pavlov tells of one of his collaborators who stubbornly held to the opinion that the mental life of man and the higher animals was so exalted and unique that not only could it not be usefully investigated by physiological methods, but would even be sullied by such attempts. In reference to this instance, Pavlov says: "We must not close our eyes to the fact that true and consistent natural science cannot reach out to the ultimate boundary of life without incurring serious misconception and opposition on the part of those who have always been accustomed to regard this realm of natural phenomena from another point of view, and recognize this point of view as the only natural and legitimate one in the given case."[1]

Both the basic and fundamental principles of Pavlov's theory, and his broad and always experimentally demonstrated deductions make it necessary for many who turn to it for aid in problems pertaining to the physiology and pathology of the nervous system or in medical, clinical problems to undergo a radical change of mind and to renounce many generally accepted, popular and customary views and opinions.

The Pavlov trend helps to shatter the erroneous concepts of the theory of heredity closely associated with the names of Weismann, Mendel and Morgan; it demands the definite abandonment of the false and harmful dogmas of the Virchow theory; it convincingly shows the utter incompatibility of the theory of the higher nervous activity with all hangovers of the idealistic outlook, with dualism or the neovitalist trends.

As early as 1900, Pavlov said: "The trouble is that the dualism which regards the soul and the body as quite separate things is still too firmly ingrained in all of us; for the scientist, of course, such a differentiation is impossible."[2]

And returning to this subject more than thirty years later, he wrote: "As to man, do we not still hear talk about freedom of will, and is there not a rooted conviction in many minds that there is something in us which is beyond determination?... I should not be committing a great error in assuming that this conviction persists among some of the psychologists, masked by references to the *peculiar nature of psychical phenomena*, behind which, in spite of the seemingly scientific arguments, can be detected the dualism and animism that is still unreservedly accepted by many thinking people, to say nothing of religious believers."[3]

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[1] I. P. Pavlov, *Complete Works*, Vol. III, pp. 57-58.
[2] *Ibid.*, Vol. II, p. 593.
[3] *Ibid.*, Vol. III, pp. 436-37.

As we have already said, the pathophysiology of the higher nervous activity was being developed in Pavlov's school in close and inseparable connection with the physiology of the higher parts of the nervous system.

And, indeed, it would be difficult to imagine how pathological physiology could fruitfully develop except in the closest interconnection with normal physiology.

In point of fact, experimental work in the pathology of the animal brain began in Pavlov's school with the first appearance and development of the theory of the higher nervous activity.

In the initial stage of this work, Pavlov excised various parts of the cerebral hemispheres (sometimes he removed the hemispheres altogether), and then studied the animals by the method of conditioned reflexes, his objects being:

First, to elucidate the functional importance of the removed part in the entire activity of the brain from the nature of the disturbances of the higher nervous activity resulting from its removal.

Secondly, to study the local and general pathological disturbances of the course and interaction of higher nervous processes following the removal of one or another part of the cerebral hemispheres, and to elucidate common and differing features in all such cases.

Thirdly, to follow step by step the successive development of pathological states of the nervous system, that is, the course of development of experimentally induced pathological disturbances of nervous activity.

Fourthly, thoroughly to investigate the successive stages of restoration of brain functions disturbed by drastic operations, and also to study the nervous mechanisms by which the defect, the damage to the nervous system, is compensated, levelled out, obliterated.

Fifthly, to elucidate all these problems by means of a strictly objective investigation of experimentally induced disturbances of higher nervous activity, categorically and completely rejecting all attempts to give a psychological or psychopathological interpretation of the disturbances.

All these problems were brilliantly solved by I. P. Pavlov with the help of his numerous disciples, of whom G. P. Zeleny, L. A. Orbeli and N. I. Krasnogorsky deserve special mention.

However, Pavlov was far from satisfied with the method of partial destruction or ablation of various parts of the hemispheres, which, he himself has said, is "handicapped by serious shortcomings." He sought for more delicate and perfected methods of investigating the functions of the various parts of the brain, and he enjoined those who carried on his work in this field to do likewise.

The importance of the stage in Pavlov's scientific activity just described lies above all in the fact that in the course of a prolonged and detailed study of the functional structure of the cerebral hemispheres, the foundations were laid of an entirely new and original theory regarding the dynamic localization of functions in the brain, a theory which is the exclusive product of our Russian science, and which is of the greatest value for neuropathology and psychiatry, for the clinical treatment of neuropathologic and neuropsychic disorders.

In place of the old theory of localization of functions, traditionally based on attempts to establish a relation between psychological concepts and anatomical facts, and bereft of all physiological foundation, Pavlov founded his new theory, which is based on the principle of relating the dynamics of nervous processes to the structure of the brain, that is, studying the course and interaction of nervous processes in the brain both in normal and pathological states, studying the fluctuations and changes in the spread of these processes in the brain, and endeavouring, if I may so express it, to impose a neurodynamic pattern on the morphological canvas of the brain tissue.

It is the honourable task of our young Soviet scientists—physiologists, morphologists, pathophysiologists and neurosurgeons—to carry on and develop to the utmost Pavlov's ideas relative to this new theory of the dynamic localization of functions, as well as to the localization of pathological disturbances of cerebral activity, which is of particular importance to clinical medicine.

But the significance of the experimental investigations of Pavlov and his school at this stage is by no means confined to the work done in the field of the theory of localization. What is perhaps most important of all is that the aforementioned diseases of the nervous system, artificially induced by Pavlov in dogs, are, as it were, rough and simplified models of organic lesions of the human brain, chiefly lesions of traumatic origin.

It is natural, therefore, that a detailed and thorough experimental investigation of pathological states induced in animals by destroying various parts of the brain should help us considerably in forming a correct idea of those general and local disturbances of neural and neuropsychic activity which are observed in the case of various organic lesions of the human brain. More, it helps us to understand the nervous mechanisms which underlie the process of restoration and compensation of disturbed functions, and, consequently, it helps the discovery of means of assisting these restorative processes.

Need it be said how important these investigations are for the clinic, for practical medicine, and what broad prospects they open up for further investigations that will more deeply elaborate and extend Pavlov's ideas.

It has regretfully to be admitted, however, that the data obtained by Pavlov and his collaborators from their study of pathological changes in the higher nervous activity caused by experimental injury (extirpation) of the cerebral hemispheres are still being put to very little use by clinicists. Yet the ideas embodied by Pavlov in these investigations are undoubtedly of great importance to all the departments of medicine which deal with organic lesions of the central nervous system, especially those of traumatic origin.

Pointing out a number of difficulties which stand in the way of the study of the higher forms of reflex activity, Pavlov says: "Of course, the most difficult and exacting work that had to be done, and still has to be done, is that relating to the central station, and, of the parts of the central station, to the grey matter, and of the grey matter, to the cerebral cortex. This work concerns both the visible structure itself and the dynamic processes taking place in it, and, of course, the fact is never lost sight of that structure and dynamic processes are invariably connected. Because of the different methods of studying structure and dynamic processes, it is natural that the investigations should for the most part be divided between the histologist and the physiologist."[1]

Soviet science may today pride itself on possessing a number of brilliant adepts in the morphology, and, in particular, the pathological morphology, of the brain.

Soviet morphology has a splendid mastery of all the most complex and perfected methods and techniques of studying the delicate structure of the higher parts of the nervous system. It is intensively working on various problems of brain cyto-architectonics, and in this field it has not only overtaken, but has possibly outstripped foreign investigators. But can it be said that it is devoting sufficient attention to the problem of the interrelation between the dynamics of the nervous processes and the structure of the brain which so interested Pavlov? Are our physiologists and histologists working in conjunction for the solution of these difficult but important problems—important not only for the physiology and morphology of the brain, but also for clinical medicine, above all for the clinical treatment of nervous and neuropsychic disorders?

The problem of the interaction between the morphology and the physiology of the brain consists, it seems to me, not only in establishing the physiological peculiarities of the various cyto-architectonic areas, but also in demonstrating the morphological basis at least of the principal laws of governing the course and interaction of the cortical processes described by I. P. Pavlov. This would be of very great value also for the pathophysiology of the higher parts of the nervous system.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 438.

Thus, in the initial stage of development of the pathophysiology of higher nervous activity, Pavlov's attention was centred on investigating pathological states resulting from artificial (surgical) lesions of various parts of the brain.

The ideas which governed Pavlov's investigations at this stage were after his death carried on and developed by his disciples principally along the following lines.

O. S. Rosental and his collaborators, by removing various parts of the cerebral cortex in dogs and then carefully and perseveringly studying the conditioned reflex activity of the animals, have added greater detail and precision and have generally multiplied the data obtained in Pavlov's lifetime. Of his numerous experimental investigations, particularly interesting are his attempts to connect the physiological data he has obtained with those derived from study of the cyto-architectonics of the brain.

M. A. Usiyevich, performing on dogs the operation known as lobotomy, that is, sectioning the white matter in the area of the frontal lobes, sometimes only on one side and sometimes on both, has made a detailed study of the various pathological disturbances of higher nervous activity to be observed in such cases. These investigations are of particular interest because attempts have lately been made abroad, especially in America, but also in some of our Soviet psychiatric institutions, to treat certain psychoses, most often cases of chronic schizophrenia, by lobotomy. Usiyevich's investigations, in which the work of the physiological laboratory is combined with clinical practice, are indicative of the need to exercise extreme caution in assessing the therapeutical value of lobotomy.

Much has been done in the way of carrying on and further developing Pavlov's ideas by E. A. Asratyan.

A series of experimental investigations conducted by him in the period 1938-49 have considerably enlarged and supplemented the recorded results of studies of decerebrated animals. Asratyan has made a detailed investigation of disturbances of the vegetative functions in such animals, trophic disorders, changes in the relative length of sleep and waking periods and so on.

While Pavlov was still alive, one of his disciples, L. A. Andreyev, started investigations of disturbances of higher nervous activity in animals caused by artificial anemization of the cerebral cortex, obtained by ligating the carotid and vertebral arteries. Asratyan greatly perfected this method, and instead of ligating the arteries, artificially increased the static pressure in the subdural space of the brain. He not only substantially supplemented Andreyev's data on the disturbances caused by anemization, but also made wide use of this method in studying the restorative processes in the cerebral cortex which result from compensation and regression of the pathological states caused by anemization.

A series of valuable studies have been made by Asratyan and his collaborators of the role of the cerebral cortex in the development of the adaptive nervous mechanisms which compensate various kinds of lesions artificially caused to animals by the amputation of one or two limbs, by partial longitudinal or transverse sectioning of the spinal cord, by sectioning its posterior roots or peripheral nerve trunks, and so on.

Lastly, basing himself on Pavlov's concept of protective inhibition, Asratyan has successfully applied sleep therapy, treatment by prolonged narcosis, in cases of various traumatic lesions of the nervous system artificially induced in animals.

We thus see that the scientific ideas enunciated by Pavlov in the first stage of development of the pathophysiology of the higher nervous activity have been further elaborated in the work of a number of his disciples.

It should be stressed that this work was to a large extent conducted with the object of connecting the pathophysiology of the higher nervous activity with practical medicine, in particular, with the treatment of various brain diseases, but that it is at the same time of great theoretical interest.

It may be truly said that in this work we have an application of one of Pavlov's basic conceptions, namely, that **experimental pathology must be brought into the closest** possible contact with experimental therapy.

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If in the first stage of development of the pathophysiology of the higher nervous activity Pavlov's attention was centred on disturbances in the cerebral activity of the animal resulting from lesions artificially caused by surgical intervention, and representing simplified models of organic lesions of the central nervous system in man, in the second stage his attention was focussed on pathological disturbances of higher nervous activity resulting from various noxious influences bearing a functional character.

Most of the pathological states observed in such cases too represented simplified models of disturbances of the human nervous system, only not of organic, but of functional origin—neuroses, or so-called psychogenic or reactive states and mental disorders associated with certain somatic diseases, particularly of endocrine origin.

This branch of the Pavlov pathophysiology of the higher nervous activity is widely known as the theory of experimental neuroses.

Thus for the first time in the history of science living models of functional disorders of the nervous system were obtained in the laboratory.

Such disorders were intensively studied by Pavlov particularly in the last fifteen or sixteen years of his life, his closest collaborator in this work and its most active continuer after his death being M. K. Petrova, who died only a little while ago.

Pavlov's theory of experimental neuroses, and of functional disorders of the brain generally, is widely known, and I shall therefore not dwell upon it specially, but only recall the major stages in its development.

Let us remember, first of all, that this theory was developed by the Pavlov school in close connection with the study of various types of higher nervous activity in animals, and that great attention was paid to the role of the external environment in the formation of the type, the influence of environmental conditions, and especially of training, on the features and modifications of the type. Various difficult tasks demanded of the animals' nervous system in the course of the experiments, in order to elucidate their typological peculiarities, often resulted in clearly marked disturbances of their higher nervous activity, resembling in rough and simplified form mental trauma, emotional shock or mental fatigue.

This artificially produced overstrain of the nervous system, usually due to a painful collision, a struggle, a conflict between the processes of nervous excitation and inhibition, resulted in the end in a breakdown of the higher nervous activity, and provided opportunities for the study of a number of experimental neuroses of different form, duration and severity.

At the same time, laboratory studies were made of various methods of treating these disorders. And the remarkable fact was elucidated that treatment, if it is to be successful, must be adapted to the peculiarities of the type of higher nervous activity of the sick animal, which is of very great importance for pharmacology and clinical medicine.

It was also elucidated as the result of detailed and prolonged investigation that, contrary to the accepted opinion, small doses, even microdoses, of bromides were in many cases more effective than large doses.

As in all his other fields of work, Pavlov closely associated experimental pathology of the higher nervous activity with experimental therapy and pharmacological research. "The potency of our knowledge of the nervous system," he said, "will, of course, be much greater if we learn not only to damage the nervous system, but also to repair it at will."[1]

Quite in the early stages of the study of experimental neuroses, M. K. Petrova and others observed that these disorders were usually accompanied by various somatic disturbances: abnormal respiration and salivary secretion, eczema, ulcerative processes, otitis, etc.

All this went to show that experimental disorders of the higher nervous activity also involved the vegetative nervous system, that disorders of the higher parts of the nervous system were at the same time disorders of the organism as a whole.

In some of the disorders caused by difficult experimental tasks resulting in overstrain of the nervous system, the somatic disturbances were even more clearly marked and more severe than the disturbances of higher nervous activity.

But Pavlov was interested not only in pathological states of higher nervous activity caused by *external* noxious influences deliberately applied.

Studies, chiefly by M. K. Petrova, of a large number of castrated dogs revealed that distinct functional nervous disorders may in many cases be obtained by experimentally induced disturbances of the *internal* environment of the body, notably of the work of the endocrine system.

It appeared that even when a defect artificially caused in the *internal* environment of an animal was well compensated, the animal nevertheless displayed a peculiar nervous instability and a heightened susceptibility to *external* unfavourable influences. In such an animal, a pathological state of the higher nervous activity would often arise even when the task set for it in the experiment was not very difficult, and this state was of an unusually severe form.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, p. 545.

Let us recall also that during Pavlov's lifetime clearly marked disturbances of the cortical activity were obtained in dogs by E. A. Asratyan as a result of experimental lesion of the vegetative nervous system, namely, section of the sympathetic trunk of the neck. These experiments, together with the results obtained by M. K. Petrova, helped, in their turn, to explain the role of certain pathogenic mechanisms in the origin of functional disorders of higher nervous activity caused by primary derangements in the internal environment of the body, notably by lesions of the sympathetic nervous system.

After Pavlov's death, the work in experimental pathophysiology of functional disorders of the brain was carried on by M. K. Petrova, who over a period of many years worked on the elaboration of the scientific ideas of her teacher in this field with supreme energy and passionate interest.

She added substantially to our knowledge of experimental neuroses. For instance, she obtained various forms of experimentally induced phobias; she made a detailed study of pathologically prolonged excitation; she gathered a vast amount of data on distrophic changes of the skin and other somatic disturbances caused by breakdowns of higher nervous activity, and so on. Of exclusive interest are her observations of and experiments on the influence of experimental neuroses and chronic overstrain of the nervous system on the genesis of tumours, both benign and malignant.

M. K. Petrova did a great deal in the treatment of experimental neuroses, especially in connection with the work of Pavlov's clinic in treating such diseases by sleep therapy. It is interesting that she established that sleep therapy was beneficial in the treatment not only of experimentally induced disturbances of the higher nervous activity, but also of various somatic disturbances associated with them. This naturally suggested the idea of applying prolonged sleep in clinical medicine, in the treatment of systemic disorders caused by overstrain of the nervous system.

The death of Professor Petrova has been a severe blow to the development of Pavlov's experimental pathophysiology of the higher parts of the central nervous system.

The work of Petrova and Asratyan on disorders of the higher nervous activity caused by artificial disturbances of endocrine and vegetative functions has been successfully continued by a number of other disciples of Pavlov.

The researches of K. M. Bykov and his numerous disciples should undoubtedly have a great influence in advancing research in pathological changes of the higher nervous activity connected with disorders of internal organs.

Much valuable work in enlarging and deepening our knowledge of the pathophysiology of functional disorders of the nervous system in animals, and in developing Pavlov's ideas in this field, has been done since his death by M. A. Usiyevich and A. O. Dolin and their collaborators.

The experimental investigations which Usiyevich began in Pavlov's lifetime and has been continuing since have shown that various kinds of overstrain of the nervous system of dogs which lead to a breakdown of higher nervous activity are accompanied by more or less distinct disturbances of the functioning of internal organs, and by blood changes. For instance, increased or diminished diuresis is observed, also disturbances of bile secretion, alterations in the peristalsis of the empty stomach, considerable fluctuation in the concentration of active chemical agents in the blood and, what is particularly interesting from the standpoint of the treatment of systemic disorders, a prolonged and persistent increase of gastric secretion and a markedly increased blood pressure, which then becomes stabilized at a high level.

In Usiyevich's experiments, treatment of artificially induced disturbances of higher nervous activity in animals usually resulted in the normal functioning of the internal organs.

A. O. Dolin's studies of abnormal conditioned reflexes are of great interest.

By injecting aconitin, camphor, bulbocapnin or other substances coincidentally with some indifferent stimulator, he transformed these originally quite harmless agents into conditioned stimuli of severe pathological reactions. Then applying these stimuli, he obtained either a conditioned reaction in the shape of distinctly marked disturbances of cardiac activity, or conditioned catalepsy, or a conditioned reflex in the shape of convulsions, and so on.

It was thus experimentally shown that under certain conditions the vegetative and somatic activity of an experimental animal can be completely disturbed by the formation of an abnormal temporary connection acting through the cerebral cortex. However, Dolin showed in further experiments that the treatment of the artificially produced disturbances may be similarly achieved through the cortex—they may be inhibited and the normal state of the organism's internal environment restored.

The work of M. K. Petrova, K. M. Bykov, E. A. Asratyan, M. A. Usiyevich and A. O. Dolin open up broad prospects for the advancement of the ideas underlying Pavlov's theory of the higher nervous activity in various branches of clinical medicine.

The work of Petrova, and later of V. S. Deryabin, I. S. Tsitovich and Y. P. Frolov threw light on the disturbances of cortical activity caused by certain intoxications. They also showed that the course of such disturbances differed in different types of nervous systems.

The special task of our laboratory for the last five years has been to make an all-round study of nervous diseases caused experimentally in animals by various toxic substances, and to elaborate methods of treatment. Thus here too Pavlov's line has been followed and experimental pathology of the nervous system has gone hand in hand with experimental therapy.

The experimental work done in our laboratory by Kotlaryevsky, Gorsheleva, Khozak, Faddeyeva and Izergina has been mainly directed along the following lines.

Investigators have usually concentrated their attention chiefly on the *differences* in the clinical pictures of various intoxications, and on the specific influence of each form of intoxication on the nervous system. While not renouncing the study of differences and peculiar features, we nevertheless, because of certain considerations, focussed particular attention on points of *resemblance,* on common features in the action of seemingly entirely different toxic substances on the functions of the higher parts of the nervous system, and its reactions to these substances. It was from this aspect that we studied disturbances of nervous activity caused by mescalin, bulbocapnin, plumbum tetra-aethylum, staphilococcal and streptococcal toxin, etc.

Time does not permit me to discuss here all the common features in their action which we have discovered.

I shall only say that in all cases it was the evolutionarily younger functions of the brain, especially the latest conditioned connections and processes of internal inhibition, that were affected first, most powerfully and for the longest duration; and that the oldest, most ancient functions of the nervous system were affected latest, and, on the contrary, were the earliest to be restored in the process of rehabilitation.

The influence of the type of higher nervous activity of animals on the course of the various intoxications was very distinct and moreover highly diverse.

If the intoxication was preceded by experimental overstrain of the animal's nervous system and a breakdown of higher nervous activity, its course in the majority of cases was very severe and protracted. It followed from this that in such cases more than in others, treatment must be directed not only to detoxicate the organism, but also to restore the disturbed higher nervous activity.

If we were dealing with a human being and not an animal, we would say that he not only needed detoxication, but also treatment of his neuropsychic activity—in particular, scientifically sound psychotherapy.

Carefully studying the development of various intoxications, we were in many cases able to observe, at various stages of the disease and in its various forms, the development of a diffused protective inhibition in the higher parts of the animals' nervous system. Following the therapeutic principle established by Pavlov, it was quite natural on our part to attempt to strengthen and extend this protective inhibition with the aid of sleep therapy. And, indeed, by inducing prolonged narcotic sleep with the aid of phenobarbital and always timing it for the stage when the protective inhibition was most clearly marked, we in many cases of neuro-intoxication obtained excellent therapeutic effects, namely, the complete disappearance of the severe disorders of higher nervous activity in the experimental animals.

However, this work is still in its initial stage and does not yet furnish ground for categorical assertions or definite conclusions.

As we see, the scientific ideas that led Pavlov to the second stage of development of the pathophysiology of higher nervous activity—that is, to the numerous investigations by the Pavlov school devoted to the study of pathological disturbances of the higher nervous activity caused by functional influences, in the form of difficult experimental tasks or of noxious agents introduced into the internal environment—these ideas, as we see, are being carried on and elaborated from many different angles. This, however, applies almost exclusively to the laboratory investigations of some of Pavlov's disciples who are studying the pathophysiology of the higher nervous activity.

But as to general pathological physiology, it unfortunately cannot yet be said that the theory of the higher nervous activity has here found a favourable soil for its further development, or that close contact has been established between it and the basic problems of that science.

It is to be presumed that the energetic struggle which

Academician A. D. Speransky, founder of his own original trend in Soviet pathology, and his disciples have lately been waging against Virchowianism will create more favourable conditions for the broad penetration of Pavlov's theory of the higher nervous activity into pathology.

It is scarcely necessary to mention here the importance for general pathology of Pavlov's work on the physiology of blood circulation and digestion, and also of his scientific views on trophic innervation.

As you know, the third and last stage of Pavlov's work on the pathology of higher nervous activity was his remarkable investigations of nervous and neuropsychic diseases conducted in the clinic founded at his request in connection with his laboratories. It was here that Pavlov's ideas on "nervism" attained their highest development, and here that the great physiologist came closer than ever before to problems of clinical medicine.

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However, before discussing the lines of development of Pavlov's scientific ideas in the last stage of his work on the pathophysiology of the higher nervous activity, permit me to draw your attention to certain matters which have a close bearing on the further development of Pavlov's theories in general.

During Pavlov's lifetime, investigations of the physiology and the pathology of the higher nervous activity were conducted in his laboratories in very close connection.

And today, too, the advancement of the *pathophysiology* of higher parts of the nervous system to a large extent depends on the successful development of the *physiology* of these parts. Its successful development is of the greatest importance to the pathophysiology of the higher nervous activity.

We know that in many countries, because of the political situation, one characteristic feature of which is the increased aggressiveness of militant idealism, the basic ideas of the theory of the higher nervous activity are in recent years meeting with very severe opposition, in the shape of criticism so biased, prejudiced and unfair as to be sometimes indistinguishable from sheer vilification.

It is the duty of the disciples and successors of I. P. Pavlov to develop the scientific ideas of their great teacher unflaggingly, to adhere to the basic precepts of his teachings undeviatingly, and, above all, to interpret these precepts accurately and precisely.

But it must be said bluntly and frankly that, unfortunately, as K. M. Bykov has also pointed out, all is not quite as it should be with the development of the theory of higher nervous activity since Pavlov's death.

Pavlov himself was never ashamed to criticize his mistakes. In his penultimate lecture on the activity of the cerebral hemispheres, for instance, he says: "In conclusion, I shall speak of the mistakes which we committed in no small number in the past, and which we have been, and are, gradually correcting."[1]

But it is not so much the recognition of mistakes that I want to speak of.

Since Pavlov's death it has become very evident, on the one hand, that some of his basic concepts are contested and distorted by some of our physiologists; on the other, it is becoming increasingly clear that a number of very important aspects of the theory of the higher nervous activity are understood and interpreted differently by different disciples of Pavlov.

This situation needs thorough examination; a number of questions must be clarified; there must be complete mutual understanding and coordination of effort in the further elaboration of Pavlov's scientific ideas in the theory of the higher nervous activity created by his genius.

Academician I. S. Beritov wrote in 1932: "The Pavlov and Bekhterev schools establish a great number of laws for the interpretation of the activity of the individual. But, as we have had many an occasion to convince ourselves, these schools utterly disregard the laws of the general physiology of the central nervous system, and the laws they have created are consequently often in clear contradiction to the latter. These laws are therefore of a purely hypothetical character, suitable only for the systematization of facts, but not for their scientific explanation."

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[1] I. P. Pavlov, *Complete Works*, Vol. IV, p. 321.

And, a little further on: "That is why I consider that the attempt made in this monograph at a purely physiological description of the activity of the individual should be taken as the starting point in the creation of a genuine physiological theory of the complex nervous activity of man and animals."[1]

As we see, Academician Beritov, writing in 1932, considered that in establishing specific laws of cortical activity, the Pavlov school were ignoring the general laws of activity of the central nervous system, laws that extend to all other parts of the nervous system, the spinal cord, for instance. Beritov further considered that a genuine physiology of complex nervous activity was being built not by Pavlov, but by Beritov.

In another of his monographs, written in 1947, I. S. Beritov has the following to say regarding the investigations of the cortical processes conducted by the Pavlov school: "The Pavlov school regard all these peculiar phenomena in the vital activity of the organism of the dog from the standpoint of the laws of nervous activity known from a study of the spinal cord of decerebrated animals."[2]

It thus appears that the Pavlov school ignore the specific peculiarities of cortical activity and explain the latter from the standpoint of the laws of activity of the spinal cord.

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[1] I. S. Beritov, *Individually Acquired Activity of the Central Nervous System*, 1932, p. 433.

[2] I. S. Beritov, *Principal Forms of Nervous and Psychonervous Activity*, Academy of Sciences of the U.S.S.R., 1947, p. 74.

It is very well known that, actually, Pavlov distinguished in the activity of the cerebral cortex, first, laws common to the activity of other parts of the nervous system, such as nervous conduction, summation, induction, etc., and, secondly, laws specific to cortical activity, such as, in the case of the higher animals, the coupling function, the processes of higher synthesis and analysis, and the phenomena of internal or conditioned inhibition, and, in the case of man, principally the second signal system.

It follows from this that, both in 1932 and 1947, Academician I. S. Beritov unfortunately betrayed an inadequate acquaintance with Pavlov's theory of the higher nervous activity and an incorrect understanding of this theory, but nevertheless thought himself justified in asserting that it was he, and not Pavlov, that was building a genuine physiology of complex nervous activity.

Obviously, Academician I. S. Beritov's views on the physiology of the higher nervous activity were not such as to satisfy, and still less earn the approval of those who really prize Pavlov's teachings, and, in the first place, of Pavlov's disciples.

How, then, are we to understand the following statement made by one of Pavlov's disciples in 1940: "Academician Beritov's laboratory has long been working successfully on the physiology of the higher nervous activity. He has written a number of monographs on the conditioned reflexes, and I regard him as one of the best experts on the physiology of the higher nervous activity."[1] And this was written by one of Pavlov's disciples without the slightest criticism of Academician Beritov's views, which are in sharp opposition to Pavlov's theories and, moreover, based upon inadequate knowledge. How are we to understand Professor Anokhin in this case?

We shall not dwell here on the well-known charges which Professor Anokhin levels against Pavlov, and which in most cases run on all fours with those of Academician I. S. Beritov: charges of mechanicism and "deficient power of analysis"; the allegation that Pavlov underrated the phenomena of synthesis and the principle of integrality; that Pavlov's basic concepts are inadequately argued; and, lastly, that the most vulnerable spot in the theory of conditioned reflexes is that it is isolated from foreign neurology. I shall only remark that the real and fundamental point is not one of "isolation," but of an irreconcilable difference between the ideological foundations of the Pavlov theory and the idealistic and mechanistic premises of foreign neurology, which are utterly at variance with dialectical materialism. Does Professor Anokhin realize this when he accuses Pavlov of "isolation" from foreign neurology?

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[1] P. K. Anokhin, *Arkhiv Biologicheskikh Nauk,* Vol. 57, Part I, 1940.

Professor Anokhin has long possessed splendid facilities for the further elaboration of the scientific ideas of his teacher. What has he added to the basic laws of the higher nervous activity established by Pavlov? What facts of any value has he contributed? What has he done, say, for the elaboration of such important problems as the typological and age features of this activity in animals, problems which, as we know, keenly interested Pavlov, and which undoubtedly require to be studied further in the interest not only of physiology, but of medicine? What has Professor Anokhin done to connect the theory of the higher nervous activity with clinical medicine? It is difficult to find any reply to these questions in Professor Anokhin's published writings.

Beginning with the very first works published by him after Pavlov's death, Professor Anokhin has made it his chief task to revise and "correct" the basic concepts of Pavlov's teachings. For example, he considers it necessary thoroughly to revise the concept of the conditioned reflex, which, in his opinion, is "inadequately argued."

Instead of extending, in breadth and in depth, Pavlov's investigations of the phenomena of nervous analysis and synthesis, under which category, as we know, Pavlov included the formation of conditioned reflexes, Professor Anokhin prefers Sherrington's concept of integration, and declares that the chief factor determining his views of all processes of the higher nervous activity is the concept he himself advances of the *integral nature of the unconditioned and conditioned reactions of animals.* He accordingly keeps harping upon, and representing as a new discovery, the old and long-established fact that when, for example, a conditioned salivary reflex is elaborated, the conditioned reaction includes, besides the secretory, a number of motor and vegetative components.

Professor Anokhin's attempts to explain the neurophysiological basis of emotions likewise contribute nothing new to our knowledge.

Only a few months after Pavlov's death, Professor Anokhin began a radical revision of Pavlov's concept of internal inhibition and, even more widely, of cortical inhibition in general. He not only revised it but completely rejected it. And it is a curious thing that he asserts today, as he asserted fourteen years ago, that although his views on cortical inhibition contradict everything Pavlov ever published, they do coincide with plans which Pavlov never carried out but which he communicated to Professor Anokhin in private and confidential conversations. It cannot, however, be said that this has helped to promote the acceptance of Professor Anokhin's ideas by Soviet physiology.

As we know, Pavlov always believed that conditioned reflexes are formed and become established in the cerebral cortex, that they are, in the higher animals, cortical connections. But Professor Anokhin has been asserting for fifteen years, without any convincing evidence to back it, that conditioned motor reflexes become established and automatic when they pass from the cortical to the subcortical region.

Professor Anokhin regards the "functional system" concept as one of his greatest achievements, and claims to be its author. But we have only to acquaint ourselves in detail with the work done by Pavlov in the years 1910-16 to see that already at that period, when striving to establish correlations between anatomy and physiology, he observed that complex reflex acts were based on a functional union of neurons of various parts of the brain, of various levels of the central nervous system. Later, as we know, Pavlov repeatedly reverted to the question of functional, or dynamic, systems embracing the cortex and lower-brain parts. Unfortunately, Professor Anokhin's work has added nothing substantial to the "functional system" concept.

Professor Anokhin is dissatisfied with the idea of differentiation of conditioned reflexes established by the strictly objective investigations of the Pavlov school, and, in his studies of conditioned motor reactions, has replaced it by the purely psychological and absolutely subjective concept of the "reaction of active selection," thus deviating from a strictly objective physiological study of facts to a subjective psychological interpretation of them.

Nor can the following manner of substantiating his theories, of which Professor Anokhin is very fond, be considered scientifically correct: when, for instance, expounding his theory that there is no such thing as cortical inhibition, he asserts that this conforms with unpublished statements of Pavlov, that he discussed his "integral" conception of the conditioned reflex with Pavlov many a time, that the new potentialities opened up by his method of investigation were highly appreciated by Pavlov, and so on and so forth.

But in revising, reconstructing or rejecting a number of Pavlov's basic concepts, in endeavouring to furnish his own, allegedly better, interpretation of experimental data explained by Pavlov, Professor Anokhin does not help the advancement of Pavlov's ideas, and in the end arrives at conclusions which detract from the importance of Pavlov's teachings, limit their potentialities, and are incompatible with the basic physiological views of Sechenov and Pavlov.

"It was established in the course of the investigations," Professor Anokhin wrote in 1949, "that the role of the frontal areas of the cortex cannot be expressed in the terms we usually employ when studying the higher nervous activity. Neither the term inhibition, nor the term excitation, nor all their possible correlations, can express that specific contribution which the frontal areas make to the integration of the higher nervous activity."[1]

The laws of the course and interaction, synthesis and analysis of the higher nervous processes established by Pavlov relate, as we know, to the activity of the cerebral cortex as a whole. The cerebral cortex represents a complex dynamic system which is one and united in its activity, and there is absolutely no justification for eliminating, divorcing, the functions of the frontal lobes from this system, just as there is no justification, when studying the frontal lobes, for ignoring the laws of activity of the cerebral hemispheres established by Pavlov. But this, of course, should not rule out a study of the qualitative peculiarities in the activity of the frontal lobes as compared with other parts of the brain.

Professor Anokhin's views run counter to all the results of the experimental investigations of the frontal lobes made by the Pavlov school. Actually, such views do not extend and advance these investigations, but strike the pen through them.

Professor Anokhin considers that all Pavlov's basic concepts are inadequate to explain the functions of the frontal lobes, and believes that they too can only be explained with the help of the concept "integration," although it is quite incomprehensible why this concept should be preferred to Pavlov's concept of higher cortical synthesis and analysis. Convinced that the basic concepts of the physiology of the higher nervous activity are of no help in the study of the function of the temporal lobes, Professor Anokhin turns for aid to the data of psychological investigations.[1]

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[1] *Problems of the Higher Nervous Activity,* U.S.S.R. Academy of Medical Sciences, 1949, p. 7.

Thus Professor Anokhin definitely abandons Pavlov's method of strictly objective investigation of the cortical dynamics. And this is not surprising, in view of the course he has been pursuing all along of revising, without any justification, the basic concepts of Pavlov's physiology of the higher nervous activity, and reconstructing them in his own way, or even rejecting them altogether. Most assuredly, this course has not been, and will not be, of any value to the pathophysiology of the higher parts of the nervous system.

Investigators working in the field of the pathophysiology of the higher nervous activity are following with great attention and interest the investigations of the laboratory which was the cradle of the theory of conditioned reflexes. I am referring to the Pavlov Physiological Department of the Institute of Experimental Medicine, the department now headed by Professor P. S. Kupalov.

But it must be frankly stated that some features of the general trend of its work are giving rise to deep perplexity.

"We have already," writes Professor Kupalov in an article printed in February 1950, "established the existence of a special type of abbreviated conditioned reflexes, which, indeed, were predicted by that great scientist I. M. Sechenov. An external influence, in fact, may not give rise to a visible reaction in the animal, but *only to a definite internal excitation*[2] of the cerebral hemispheres, associated with what has come to be known as internal experiences, or feelings, in their various forms."[3] It will easily be seen that the reference here to Sechenov is not entirely in place. Sechenov, as we know, described delayed reflexes, the end part of which is inhibited. It is also well known that to Sechenov inhibition was not simply the absence of an effect, but a specific process. That which Professor Kupalov is describing obviously differs from Sechenov's abbreviated reflexes and Pavlov's inhibited reflexes.

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[1] *Ibid.*, p. 122.

[2] My italics.—*A. I.-S.*

[3] *Bulletin of Experimental Biology and Medicine*, No. 2, 1950, p. 87.

Professor Kupalov asserts that there may be processes which do not find expression in any visible reaction of the nervous system, but only give rise to what he terms "internal experience." But, one asks, how does Professor Kupalov detect these "internal experiences" of his dogs? And is it the function of the physiology of the higher nervous activity to explain nervous processes by referring to the "internal experience" of dogs?

"There are two types of abbreviated conditioned reflexes," Professor Kupalov goes on to say. "Some of them, started by an external stimulation, do not have the usual culmination in the form of a visible reaction. Others, though ending in an external reaction, are not started by a direct external stimulation. In the first case, the reflex ends in a specific internal excitation of the cerebral cortex; in the second, a similar internal excitation itself starts the reflex. These states of internal excitement, in fact, represent the various internal experiences of the animal, its subjective world."[1]

It follows from this that besides those manifestations of nervous activity determined by external and internal stimulations which were described by Pavlov as conditioned and unconditioned reflexes, there are, according to Professor Kupalov, other forms of animal behaviour which are determined neither by external nor by internal influences, which depend neither upon the external nor the internal environment of the organism, but are a manifestation of the animal's internal experiences, originate in its subjective world, and are an expression of an "internal excitement" which comes no one knows whence. In one of his writings,

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[1] *Bulletin of Experimental Biology and Medicine,* No. 2, 1950, p. 87.

Professor Kupalov draws an analogy between his concept "internal excitement" and the Pavlov concept of internal inhibition.[1] But this is an unsound analogy, since, according to Pavlov, the processes of internal inhibition are always a response to one or another stimulation, whereas the characteristic feature of internal excitement is that, according to Professor Kupalov, it is not predetermined by any stimulation and "primarily forms" in the cerebral cortex, is a primary, "independent," spontaneous excitation of the cortical cells.

Reactions in an animal may be stimulated, Professor Kupalov says, "not only by processes of sensation and apperception, but also by the animal's feelings and emotions."[2]

Professor Kupalov regards the former as ordinary conditioned reflexes, and the latter as products of "internal excitement." But who does not know that precisely in those reactions of the animal which from the zoo-psychological standpoint are emotional or affective, their dependence on external or internal excitations is most clearly apparent, that is to say, their determined, their conditioned-reflex or unconditioned-reflex nature is quite obvious.

Not content with describing nervous processes which are in no way expressed either in the dog's external or internal environment, and only end in "internal, subjective experiences," not content with describing "reflexes" which originate in the cerebral cortex, are not dependent upon any stimulation and are produced by the animal's "internal experiences," Professor Kupalov describes yet another category of "abbreviated reflexes." "Data has lately been obtained," he says, "pointing to the existence of internal reflexes of the cerebral cortex itself, when one functional state of the cortex calls forth another functional state."[3]

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[1] *Thirty Years' Achievement of Soviet Medical Science,* U.S.S.R. Academy of Medical Sciences, 1947, p. 77.

[2] *Ibid.*

[3] *Ibid.*

Thus, to reflexes which have no end and reflexes which have no beginning, Professor Kupalov adds reflexes which have neither beginning nor end. If we wanted to define briefly the basic features of the views of Professor Kupalov just described, we should have to say the following:

1. We are well familiar with Sechenov's and Pavlov's conception of the reflex act. They regarded it as a functional union of three essential components—the receptor, the central-coupling, and effector—in the shape of a positive and inhibitive reaction. From the standpoint of the reflex theory *as Pavlov understood it*, the things that Professor Kupalov describes are not reflexes and cannot be termed such.

2. The data cited by Professor Kupalov are incompatible with the deterministic conceptions of Sechenov and Pavlov, because Professor Kupalov assumes the existence of forms of activity of the higher animals which are determined neither by external nor by internal stimulations, and are, consequently, not dependent on influences of the organism's external or internal environment, but are of a spontaneous character.

3. Professor Kupalov, in his conception and explanation of the details of animal behaviour he studies, deviates from Pavlov's strictly objective method of investigation and from the fundamental principles of Pavlov's physiology of the higher nervous activity, inasmuch as he attributes certain acts in the behaviour of animals to their internal experiences, explains them as an expression of their subjective world, as an external manifestation of their feelings, emotions, etc. In other words, Professor Kupalov is digressing from the path of strictly objective physiological investigation into the old zoo-psychological path which Pavlov repudiated.

Academician I. S. Beritov, on page 47 of his monograph, *The Principal Forms of Nervous and Psychonervous Activi-*

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[1] *The Principal Forms of Nervous and Psychonervous Activity*, U.S.S.R. Academy of Medical Sciences, 1947.

ty,' remarks with obvious satisfaction that Professor Kupalov's views have not been uninfluenced by his, Academician Beritov's work. We must certainly agree with him. Professor Kupalov is one of Pavlov's oldest disciples and collaborators. It is therefore natural to expect him to be one of the firmest and most consistent promoters of Pavlov's theory of the higher nervous activity. His work in this field might be of invaluable help in further developing the pathophysiology of the higher parts of the central nervous system.

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One of the most important problems of the physiology, and the pathophysiology, of the higher nervous activity is the relation between the subjective and the objective. And it is also one of the most difficult problems.

In the study of the higher nervous activity of man, this problem, as we shall see later, is closely connected with another and no less important problem—the interrelation between the first and the second signal systems.

Vladimir Ilyich Lenin says in his *Materialism and Empirio-Criticism* in reference to Ludwig Feuerbach's views on the "thing in itself": "Sensation is a subjective image of the objective world...."[1] and expanding this idea in another place in the same book, he says: "The fundamental distinction between the materialist and the adherent of idealist philosophy consists in the fact that the sensation, perception, idea, and the mind of man generally, is regarded as an image of objective reality."[2] In Lenin's *Philosophical Notebooks*, where he summarizes Hegel's *Science of Logic*, you will find the following remark: "Human concepts are subjective in their abstractness, their isolation; but in their integrity, their process, their sum total, their trend, their source, they are objective."[3] "For every scientist who has not been led astray by professorial philosophy," Lenin says in *Materialism and Empirio-Criticism*, "as well as for every materialist, sensation is indeed the direct connection between consciousness and the external world; it is the transformation of the energy of external excitation into a state of consciousness."[1]

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[1] V. I. Lenin, *Materialism and Empirio-Criticism*, Eng. ed., Moscow 1947, p. 117.

[2] *Ibid.*, p. 274.

[3] V. I. Lenin, *Philosophical Notebooks*, Gospolitizdat, 1947, p. 180.

I. M. Sechenov, as we know, regarded sensations as both subjective and objective,[2] and I. P. Pavlov considered them to be the simplest subjective signals of the "objective relations of the organism to the external world."[3]

Reflecting objective reality, mental activity is not only experienced subjectively, but finds objective expression in diverse forms of external activity and in various influences on the activity of the internal organs, thus representing a unity of subjective and objective.

While by no means denying the existence of internal mental experience, but always regarding mental activity as higher nervous activity, Pavlov, as we know, studied it with the help of the strictly objective method he had devised for this purpose, the neurodynamic method, if we may so call it.

We know that Lenin regarded the task of scientific psychology to be to study "the material substratum of mental phenomena—the nervous processes"[4] and in this way to explain these phenomena.

This was precisely the line taken by Sechenov.

Pavlov considered that the concepts of psychology must be explained by data obtained from a strictly objective investigation of the higher nervous activity. It was precisely in this way that he conceived the superimposition of the phenomena of mental activity on physiological facts, the "amalgamation" of psychological and physiological, the establishment of relation and coincidence between that which was formerly described by the subjective psychological method and that which is obtained by objective physiological research. That higher functioning of the brain which we call mental activity, was conceived by Pavlov as a unity of subjective and objective.

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[1] V. I. Lenin, *Materialism and Empirio-Criticism*, Eng. ed., Moscow 1947, p. 44.

[2] I. M. Sechenov, *Reflexes of the Brain*, Leningrad, 1926, p. 104.

[3] I. P. Pavlov, *Complete Works*, Vol. IV, p. 101.

[4] V. I. Lenin, *What the "Friends of the People" Are and How They Fight the Social-Democrats*, Eng. ed., Moscow 1951, p. 28.

From this standpoint, we must regard as absolutely erroneous, and as opening the way for subjective idealism, the position of one of Pavlov's disciples, Professor L. N. Fyodorov, who in 1930 took the stand of identifying the psychological with the subjective, and the nervous with the objective.[1]

Discussing the psychophysical problem in his *Lectures on the Physiology of the Nervous System*, Academician L. A. Orbeli writes: "The physician always begins by inquiring about the patient's subjective state. He asks him what he complains of, what he feels, what troubles him. He then asks himself what is the relation between the subjective and the objective phenomena, what corresponds or is connected with what, what cannot manifest itself without something else manifesting itself, must inevitably occur together. In order to answer these questions, it is absolutely essential, in addition to an objective study of the physiological functions, to study the subjective world, and to compare the data obtained from the subjective and the objective studies."[2] Consequently, when a patient tells about his sensations, the physician gets an insight into his subjective world; when the physician examines his somatic state, he gets an insight into the objective symptoms. As we know, there actually does exist in medicine the traditional but highly simplified practice of dividing the results of examination of a patient into "subjective symptoms" and "objective signs." But is it right to take these extremely schematic and quite conventional ideas prevailing in practical medicine as a basis when discussing the relation between the subjective and the objective from the psychophysical aspect. For, indeed, do the internal mental, the so-called subjective, experiences, which, nevertheless, reflect objective reality more or less accurately, find external expression only in words, utterances, speech?

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[1] *Man and Nature*, 1930, No. 4, p. 26.

[2] L. A. Orbeli, *Lectures on the Physiology of the Nervous System*, 1935, p. 232.

It can scarcely be denied that these experiences are also reflected in facial expressions (for example, of pain, alarm, joy, etc.), in gestures, in actions, and even in various kinds of vegetative reactions (cardio-vascular, for instance), in which emotional experiences are usually manifested very distinctly.

And man's utterances—are they only subjective, are they not one of the objective manifestations of the activity of his brain?

And this activity of the brain, is it not at one and the same time a subjective experience and a reflection of the influences of the organism's external and internal environments?

The internal cerebral activity, experienced by the individual either as something conscious and active, or as something which to him is involuntary, automatic, as it were, finds external expression, on the one hand, in direct activity, in the form of actions, behaviour, vegetative reactions, and, on the other, in verbal activity.

From the Pavlov standpoint, we have in the former case chiefly manifestations of the first signal system of the cerebral cortex; in the latter case, manifestations chiefly of the second signal system. There is absolutely no ground for regarding direct activity as an expression of the objective, and verbal activity as an expression of the subjective. In both cases the higher nervous activity represents a unity of the objective and subjective.

We therefore positively cannot agree with Academician L. A. Orbeli that in verbal reactions, in man's speech, we have an expression of "subjective phenomena," and in other activities of the nervous system, an expression of "objective phenomena."

But this is not the only point on which we cannot agree with L. A. Orbeli, in spite of his great and indisputable achievements in certain branches of physiology. He says: "The possibility of subjectively observing our own internal world furnishes rich material enabling us to enlarge our knowledge of the functions of the brain. Indeed, when we confine ourselves solely to external objective observation of the behaviour of animals, and especially of man, what we actually find is the following picture. Imagine that you are standing in front of a building. You see scores and hundreds of people going into it, and after having been there a while, coming out again and going somewhere else.... All this you can see by standing in front of the building and observing the people going in and coming out. But you cannot form an idea of what they did inside the building."[1]

We thus see that L. A. Orbeli considers the objective method inadequate and limited not only in the study of man, but even in the study of animals. It is absolutely essential, in his opinion, "along with an objective study of the physiological functions, to study the subjective world, to compare the findings of the subjective and objective methods of investigation."[2]

"If this were not so," Academician Orbeli says a little lower down, "we could not make this comparison of mental and physiological phenomena and obtain a correct physiological explanation of the psychological phenomena. We should be depriving ourselves of the possibility of employing the most precise instrument at our disposal.... In this respect the physiology of the sense organs provides highly valuable material."[3]

Strange as it may seem, in Academician Orbeli's opinion the most precise instrument for the study of the higher nervous activity is investigation of internal experiences by the subjective method, and comparison of the data obtained in this way with physiological data.

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[1] L. A. Orbeli, *Lectures on the Physiology of the Nervous System*, 1935, p. 232.

[2] *Ibid.*

[3] *Ibid.*, p. 233.

The general trend of Orbeli's reasoning on this problem is that the subjective method leads to the mental, and the objective to the physiological, and that the data of the two must be compared.

One gets the impression that Academician Orbeli's position is that of psychophysiological parallelism.

In the collection, *Problems of the Higher Nervous Activity,* published in 1949, he says that "just as we may trace the dynamics of the nervous processes by objective observation, so we may trace it by observing their subjective manifestations; and we should aim at such a simultaneous study of the objective and subjective processes as would permit us to trace their interrelation fully and to verify the laws of the activity of the nervous system discovered by both the objective and the subjective methods."[1]

One can hardly agree that the laws of the activity of the nervous system established by the objective method stand in need of verification with the aid of subjective data. On the contrary, the data of subjective observation, of self-observation, may be verified, understood and explained with the aid of the laws of the higher nervous activity derived from strictly objective investigation.

Equally perplexing is Academician Orbeli's assertion that the distinguishing feature of man is his "subjective world."[2]

On page 798 of his latest book,[3] Orbeli says: "We are in a position both to observe patients objectively and to form a judgment of their subjective symptoms from their acts of speech."

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[1] *Problems of the Higher Nervous Activity,* U.S.S.R. Academy of Sciences, 1949, p. 750.

[2] *Physiological Journal of the U.S.S.R.,* Vol. 36, No. I, 1950, p. 14.

[3] L. A. Orbeli, *Aspects of the Higher Nervous Activity,* U.S.S.R. Academy of Sciences, 1949.

In the introduction to the second volume of *The Pavlov Wednesdays*,[1] Orbeli speaks of "Pavlov's constant tendency to self-observation," and on page 514 of the same volume he quotes the following statement of Pavlov's: "I have been presented with a book by the American psychologist Woodworth.... I first happened to read the section dealing with that department of psychology in which I have generally very little interest—the psychology based on introspection, that is, self-observation, of which I have always had a rather low opinion. His exposition of it is splendid, but it only convinced me once again how futile it is." And on the following page, he adds: "What we need is not description of phenomena, but disclosure of their laws of development. No science comes from description alone."

The tendency not infrequently to be observed in the works of Academician Orbeli to prefer the subjective method to the objective, and to regard the two as of equal value, is in sharp contradiction to many of Pavlov's well-known utterances. As early as 1906, for instance, he said: "...in the end, all data of a subjective character must pass over into the field of objective science. A mixture of the subjective and objective methods of investigation is harmful. The attempt must be made to analyze phenomena from the purely objective standpoint...."[2] A year later Pavlov said the following in relation to the same question: "The subjective method of investigating all phenomena dates back to the first man, but what has it given us? Nothing. All that has been conceived with its help must be destroyed and built anew."[3] And at about the same period Pavlov said: "The whole point is whether an analysis of so-called mental phenomena can be conducted by the objective scientific method. We say that it can."[4]

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[1] *The Pavlov Wednesdays,* U.S.S.R. Academy of Sciences, 1949, p. 6.

[2] I. P. Pavlov, *Complete Works,* Vol. I, p. 375.

[3] *Ibid.*, p. 381.

[4] *Ibid.*, p. 377.

And, it seems to me, you will not find many psychologists in our country today who would insist very strongly on the value of the subjective method.

Academician Orbeli considers that "in those temporary connections which Pavlov studied we have only a most elementary process of higher nervous activity."[1] Yet Pavlov wrote in 1935: "And so, the temporary nervous connection is the most universal physiological phenomenon in the animal world and in man too. And it is at the same time psychological, that which the psychologists call association, whether it be the formation of combinations from all manner of actions or impressions, or the formation of combinations of letters, words, and thoughts. What justification is there for differentiating between or separating what the physiologists call temporary connection and the psychologists association?"[2]

In the article of Academician Orbeli's I have just quoted, he says: "Moreover, it was found that the mechanism of formation of conditioned connections is in itself so elementary that the adult human organism by no means prides itself on elaborating new conditioned connections. It rather prides itself on that which strongly counteracts their elaboration, and which very quickly confines the elaborated reflexes within definite limits."[3]

But Pavlov says that "the temporary conditioned connection . . . becomes specialized to a point of extreme complexity and minuteness,"[4] assuming the most complicated forms, as he says, in the process, of "broadest synthesis" and "subtlest analysis."

Standing above the higher nervous activity, as understood by Pavlov, there is something, in Academician Orbeli's opinion, which now counteracts this activity, now quickly confines it within definite limits. Would it not be more correct to say that, under the influence of man's constant interaction with his external environment, above all his social environment, contradictions, conflicts, struggles frequently arise in his higher nervous activity, with the result that some processes sometimes overwhelm others, sometimes unite with them. It should be remarked that Pavlov himself gave a great deal of thought to these contradictions, to this struggle.

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[1] *Physiological Journal of the U.S.S.R.*, Vol. 33, No. 6, 1947, p. 676.

[2] I. P. Pavlov, *Complete Works*, Vol. III, p. 561.

[3] *Physiological Journal of the U.S.S.R.*, Vol. 33, No. 6, 1947, p. 676.

[4] I. P. Pavlov, *Complete Works*, Vol. III, p. 562.

Pointing out in his introduction to the collection of articles, *I. P. Pavlov. Psychopathology and Psychiatry,*[1] that the founder of the theory of higher nervous activity was fully aware of the complexity and difficulty of the study of man's higher nervous activity, Orbeli says: "That is why he absolutely refused for many years to employ the terms and concepts of human psychology in describing the behaviour of animals." Is this so? Was it not for other reasons that Pavlov renounced psychology?

In 1931, he wrote: "You have before you the living organism, all the way up to man's, which performs a series of activities, manifestations of energy. You get a direct impression, difficult to overcome, of something involuntary, spontaneous. In the case of man, as an organism, this impression is so strong as to seem an obvious truth to almost everyone, and the contrary assertion seems absurd.... And leaving man aside, is it not still believed that there are spontaneously acting forces in the animal organism? As to man, do we not still hear talk about freedom of will, and is there not a rooted conviction in many minds that there is something in us which is beyond determination? I have constantly met educated and intelligent people who are quite incapable of conceiving how it can ever be possible to study the whole behaviour of a dog, say, quite objectively, that is, solely by comparing the stimuli impinging on the animal with its responses to them, and, consequently, disregarding its subjective world, which is presumed to exist by analogy with ours. What is meant, of course, is not the temporary difficulties of research, immense as they are, but that full determination is fundamentally and in principle impossible. This conviction, it goes without saying, is even far more positive with regard to man. I should not be committing a great error in assuming that this conviction persists among some of the psychologists, masked by references to the *peculiar nature of psychical phenomena,* behind which, in spite of the seemingly scientific arguments, can be detected the dualism and animism that is still unreservedly accepted by many thinking people, to say nothing of religious believers."[1]

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[1] *I. P. Pavlov. Psychopathology and Psychiatry,* U.S.S.R. Academy of Sciences, 1949, p. 5.

The first thing that is perfectly obvious from this quotation is that Pavlov considered it correct, expedient and logical to apply the strictly objective method of investigation to man. More, he saw in the assertion that such application is fundamentally and in principle inadequate, impossible and inexpedient, a manifestation of idealistic tendencies, of dualism and animism.

It goes without saying that Pavlov intended that the extension of the strictly objective method to the study of man should also include his speech activity, that he contemplated a study not only of the functions of the first signal system, but also of the second signal system, since these systems are inseparably connected and are constantly interacting, and, in their interaction, constitute man's integral higher nervous activity.

It is also perfectly clear from this quotation that Pavlov held to the position of strict and consistent determinism, which, it seems, many of us even to this day, including some of Pavlov's disciples, find it difficult to assimilate.

Yet as early as the end of the last century, V. I. Lenin, in his *What the "Friends of the People" Are and How They Fight the Social-Democrats,* said: "The idea of determinism, which establishes the necessity of human acts and rejects the absurd fable about free will, in no way destroys man's reason or conscience, or judgment of his actions."[1]

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[1] I. P. Pavlov, *Complete Works*, Vol. III, pp. 436-37.

We know that I. M. Sechenov in his day likewise fought for the idea of determinism: "*Thought is usually regarded as the cause of action,*" he says. "And if the external influence, that is, sensory excitation, remains unnoticed, as is very often the case, then, *of course, thought is even regarded as the initial cause of the action*.... This, however, is an utter fallacy. *The initial cause of every act always lies in an external sensory excitation*, because without it no thought is possible."[2]

As we have seen, the views of Pavlov and Orbeli somewhat diverge on some of the fundamental principles of the theory of higher nervous activity. This is found very clearly reflected in the work of one of Academician Orbeli's disciples and closest collaborators, Professor G. V. Gershuni, and the latter's co-workers.

The central idea of all their work may be summed up as follows. Some stimulus is selected—an auditory one, for example, by putting verbal questions to the experimentee. By modifying the intensity of the stimulus, the thresholds of sensation are determined. This same stimulus is then used to elaborate some conditioned reflex. It is supposedly found that cases are possible when the stimulus, while giving rise to a conditioned reflex and an electrical reaction in the brain, as registered by an electro-encephalograph, does not evoke any sensation, as is ascertained by questioning the experimentee regarding his "subjective sensations."

Gershuni regards such cases as a "subsensory reaction," as a "subsensory conditioned reflex," unaccompanied by sensation. "That level of organization of nervous activity which is necessary for the formation of conditioned reactions," Gershuni writes, "undoubtedly approximates very closely to the level necessary for the rise of sensations. This, however, is approximation, not identity. The fact that under certain conditions a differentiation of conditioned and sensory reactions is possible . . . warrants the belief that differentiated sensations reflect a higher degree of organization of nervous processes than that of the simple conditioned reflexes. . . . As we know, a study of the laws of man's mental activity leads to the conclusion that even complex forms of this activity may be uncognized [e.g., Freud (1924), Jannet, Leontiev (1940, 1946)]. . . . What is a subsensory conditioned reflex from the point of view of psychology? It may be assumed that it is an elementary expression of an uncognized mental reaction."[1]

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[1] V. I. Lenin, *What the "Friends of the People" Are and How They Fight the Social-Democrats*, Eng. ed., Moscow 1951, p. 53.

[2] I. M. Sechenov, *Reflexes of the Brain*, 1926, p. 105.

It is quite incomprehensible why it was necessary to call in Freud, when there would have been far greater reason to recall I. M. Sechenov, who said that "a sensory excitation producing a reflex movement may at the same time give rise to definite cognized sensations; but it also may not."[2] Sechenov's "indefinite obscure sensations"[3] should also have been recalled.

Three features are characteristic of Gershuni's method of investigation. They are as follows:

1. The higher nervous activity is divided quite arbitrarily into two parts. One (of a supposedly higher level) is studied with the help of the subjective psychological method; the other (of a supposedly lower level) is investigated by Pavlov's strictly objective method;

2. The data obtained by the two methods are compared and discussed from the psychological point of view, the aid of certain fictitious "laws of mental activity" supposedly studied by Freud being called in. Thus, a psychological pattern is not imposed on a physiological canvas, but, on the

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[1] *Physiological Journal of the U.S.S.R.*, Vol. 33, No. 4, 1947, pp. 408-09.

[2] I. M. Sechenov, *Reflexes of the Brain*, 1926, p. 62.

[3] *Ibid.*, p. 83.

contrary, an attempt is made to explain physiological data by the subjective psychological method;

3. At the same time, Pavlov's views regarding the interrelation between the first and second signal systems are entirely ignored. Yet Gershuni's data can be correctly understood and explained solely in the light of Pavlov's theory, chiefly from the angle of the interaction between the first and second signal systems.

Indeed, the main idea of all Gershuni's work is as follows: one and the same stimulus produces two different responses in the cerebral cortex—one *direct*, in the shape of a conditioned reflex, and the other *verbal*; and for some reason it is the latter that is taken to determine whether the stimulus is sensed or not. Consequently, both the cortical processes begin with the perception of one and the same stimulus by the first signal system, but then their paths diverge: the first of these cortical processes culminates in a response through the first signal system, and the second through the second signal system, in the form of a verbal reaction, in the shape of a lingual description of the stimulus.

Under certain conditions, the first, the simpler, cortical process, which in the main takes place within the first signal system, proceeds unhampered; but the second—a qualitatively different and more complex process, which passes from the first system to the second, and consequently requires the joint activity of both systems, their interaction—is not completed. The one nervous path is in a state of readiness for action and is sufficiently excitable to accept and pass on a stimulus of a given quality and intensity, while the other is not prepared, insufficiently excitable or even inhibited.

The two nervous paths may be in these different states because of various conditions of the experiment, or the unequal degree of stability of the two cortical connections, or the peculiar functional state of the cerebral cortex in general or of each of the signal systems in particular.

Under some conditions the nervous stimulus is transmitted from the first signal system to the second, and the experimentee can adequately appreciate the excitation; under other conditions it is not transmitted, and the experimentee cannot give a verbal description of the excitation.

If the stimulus does call forth a reaction, this implies that it is perceived by the receptor cells of the cortex. This perception may be more differentiated and distinct, or less definite, obscure, as Sechenov termed it.

Thus, the question of the interrelation between sensations and conditioned reflexes as formulated by Gershuni, is conceived by us essentially as the question of the dynamic interrelation between the first and second signal systems of the cerebral cortex.

It is erroneous to make a sharp distinction between sensations and conditioned connections, and to term the former subjective mental phenomena, and the latter objective nervous processes. Subjective and objective here constitute an indivisible entity.

It is erroneous to endeavour to employ at one and the same time Pavlov's strictly objective method and the subjective psychological method, an endeavour which in fact springs from the conception of psychophysiological parallelism. Still less is there any justification for subjecting data obtained by the strictly objective method to subjective-psychological analysis.

It is erroneous to attempt to supplement and perfect Pavlov's theory with the old physiology of the sense organs. Pavlov considered that the basic shortcoming of the latter was that it is for the most part built on "subjective material," and he believed that it could be improved and perfected with the help of the theory of the higher nervous activity, and not vice versa.

What does the pathophysiology of the higher parts of the nervous system expect from physiologists?

First, that they should carry on unflaggingly the investigation of the fundamental laws of the higher nervous activity, which was Pavlov's chief and primary concern; in particular, the further investigation of the theory of types.

Secondly, that they should enlarge the scope of their investigations into the ontogenesis of the higher nervous activity of animals, a field which is unfortunately attracting very little attention.

Thirdly, that the investigation of the higher nervous activity of apes, and especially of anthropoid apes, should be advanced to a much higher level than at present.

Fourthly, that the study of the higher nervous activity of man should be prosecuted with the utmost vigour, special attention being paid to its qualitative, socially determined features.

Fifthly, that the investigation of the interaction between the first and second signal systems be further advanced. But in studying the second signal system it should not be forgotten that "language is one of those social phenomena which operate throughout the existence of a society. It arises and develops with the rise and development of a society. It dies when the society dies. Apart from society there is no language."[1]

* * *

Allow me now to revert to the last stage of Pavlov's work on the pathophysiology of the higher nervous activity —to his work in the neurological and psychiatric clinics, which, it seems to me, is not without importance and interest to other branches of clinical medicine.

The prime task Pavlov set himself in his clinical work was to understand and explain the various neurotic and psychotic phenomena from the standpoint of the theory of higher nervous activity.

When examining this or that psychopathological picture, he endeavoured to elucidate the disturbances in the course and interaction of the nervous processes, the disturbances in the dynamic relations between the various parts of the nervous system and, lastly, the disturbances between the higher nervous and the somatic activity which had given rise to the given clinical picture.

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[1] J. V. Stalin, *Concerning Marxism in Linguistics,* Pravda Publishing House, 1950, p. 19.

In this way it was established, for example, that some neuropsychic disturbances are due to pathological stasis, inertness of excitation and inhibition, phasic cortical phenomena and so on. The development of the psychopathological pattern takes place on a pathophysiological canvas.

Furthermore, Pavlov never forgot for a moment that he was dealing with living and often cruelly suffering human beings. He was always extraordinarily gentle, kind and tender with his patients.

Comparing the pathological pictures he encountered in the clinic with the disturbances of higher nervous activity which he observed in the experiments of his laboratories, Pavlov made a painstaking study of those specific features of the higher nervous activity that are common both to the normal and the sick individual.

He paid great attention to the social and family conditions of the patient, to the peculiarities of his trade or profession and his social status, the conditions in which he was reared and educated, his past life, the somatic or nervous diseases he had suffered before, the emotional shocks, mental trauma or situations of conflict he had experienced. In a word, he was keenly interested in the social conditions and relations in which the patient's higher nervous activity had formed and taken shape.

It was here, in the clinic, that Pavlov evolved the idea of the first and second signal systems, the latter of which he considered a property of the human brain specifically; and it was here that he began his clinical investigations of morbid disturbances of the interaction of these cortical systems.

"When the developing animal world reached the stage of man, an extremely important addition was made to the mechanism of the higher nervous activity," Pavlov says. "In the animal, reality is signalized almost exclusively by stimulations and the traces they make in the cerebral hemispheres, which directly lead to the special cells of the visual, auditory or other receptors of the organism. This is what we too possess in the shape of impressions, sensations and ideas of the world around us, both the natural and the social—with the exception of oral and written speech. This is the first system of signals of reality, common to man and the animals. But speech constitutes a second system of signals of reality which is peculiarly ours, and is a signal of the first signals. On the one hand, the numerous speech stimulations have removed us from reality.... On the other, it is precisely speech which has made us human, a subject on which I need not dwell in detail here. However, it cannot be doubted that the fundamental laws governing the activity of the first signal system must also govern that of the second, because it too is activity of the nervous tissue."[1]

It should be stressed that it is through the second signal system, the vehicle of verbal thought and speech activity, that, to use Pavlov's terms, "interhuman signalization," the "grand signal system of speech," is effected. There cannot be any doubt, therefore, that the historical development of the second signal system and its development during the life of each individual are socially determined. But man's first signal system likewise develops in social conditions, as well as in constant interaction with the second signal system. It would thus be erroneous to regard man's first cortical system as only a biological part of his higher nervous activity.

The inseparable connection between the development of language and the history of society, the history of peoples, was brought out very vividly, as we know, by J. V. Stalin in his *Concerning Marxism in Linguistics*.

Experimental investigation of the interaction of the first and second signal systems in children of various ages was begun in our country in the 1920's, and then Pavlov's ideas on this subject were extended to nervous and neuropsychic disorders in adults.

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[1] I. P. Pavlov, *Complete Works*, Vol. III, pp. 568-69.

In the third stage of his work in the clinic, Pavlov—and this is extremely characteristic of all his scientific activity—passed from problems of pathophysiology to problems of therapy based on pathogenesis. Bromine and combined (bromine and caffeine) treatments of neuroses were elaborated by him in the clinic on entirely new lines. Sleep therapy was practised in the psychiatric clinic for the first time, based upon Pavlov's idea of protective inhibition; prolonged narcotic sleep was also practised on new lines.

After Pavlov's death, his neurological clinic was unfortunately closed down; but it was later reopened, and its staff, headed by Professor B. N. Birman, worked energetically to develop Pavlov's ideas in the pathophysiological study and treatment of neuroses.

Pavlov's psychiatric clinic and, after the Great Patriotic War, the clinic of the Moscow branch of the Pavlov Institute extended the study of disturbances of higher nervous activity to a number of disorders which were formerly not studied specifically or not studied at all from this aspect. They include reactive states, traumatic lesions of the brain resulting from war injuries, various narcomanias, and so on. On the other hand, members of the clinic's staff (Faddeyeva, Gartzstein, Sinkevich, Seredina, Strelchuk, Mirolyubov and others) continued to work on Pavlov's ideas in the field of sleep therapy, based upon protective inhibition, employing it in various forms; they greatly extended and perfected our knowledge of the indications for this method of treatment, and studied the nervous mechanisms of its curative action.

Members of the Pavlov psychiatric clinic, working before the war in Leningrad and after the war in Moscow, have considerably advanced the study of pathological disturbances of the interaction of the first and second signal systems. Such disturbances were established and studied in the case of schizophrenia, maniacal depressive states, traumatic lesions of the brain and other complaints.

Besides cases of morbid predomination of one of the systems over the other, established by Pavlov, studies have been made of various dissociations of the interaction of the two systems, in particular, various forms of reversion to earlier stages of development. The effect of various therapeutic measures in restoring such disturbed interaction was likewise investigated.

Pavlov's ideas regarding the pathophysiology of the higher nervous activity have been further developed not only in the neurological and psychiatric clinics, where they are of exceedingly great importance; they are also of great value in the pediatric clinic, where Pavlov's theory has been successfully applied for more than forty years now by one of his oldest disciples, N. I. Krasnogorsky, and his collaborators.

Latterly, especially thanks to the widely known work of M. K. Petrova and K. M. Bykov, the theory of higher nervous activity is increasingly attracting the attention of physicians, surgeons, oncologists and workers in other fields of medicine. This has already found reflection in the work of Chernorutsky, Lang, Andreyev, Myasnikov, Vishnevsky and many others.

Psychiatrists, too, are becoming more and more alive to the close connection between disturbances of cortical activity, disorders of vegetative functions and systemic diseases. Psychiatrists, physicians and surgeons are coming to see more and more clearly and to pay increasing heed to the fact that the higher parts of the nervous system, and above all the cerebral cortex, play an immense part in the pathogenesis of somatic disorders, in the defence of the organism against injurious influences, and in the development of the restorative processes during the period of recovery.

On the other hand, some of Pavlov's disciples, and the present speaker in particular, must acknowledge a very grave shortcoming, which is that they have done very little to help our general pathophysiology to assimilate the theory of higher nervous activity.

The work of Pavlov himself and of his disciples, Petrova, Bykov, Speransky, Asratyan, Usiyevich, Dolin and others, convincingly shows that the nervous system plays an immense role in the development and regression of somatic ailments; it indicates that a disease is never confined to one particular organ or system of organs, but is reflected in the activity of the entire body; it incontestably demonstrates that therapy, if it is to be successful, must be based on a clear understanding of the pathophysiological structure of the malady, and especially of its pathogenic nervous mechanisms.

The latter are very clearly evident in the case of psychogenic vegetative disturbances, which are most frequently classed as neuroses, as well as of systemic disorders in the etiology of which psychogenic factors play a considerable part.

Disturbances of normal interrelations between cerebral activity, the functions of the vegetative nervous system and the activity of the internal organs may take different courses. But perhaps the one deserving most attention is the following: under the influence of various unfavourable conditions leading to overstrain of cortical activity, there arise in the cerebral cortex, in conjunction with general dynamic changes, what might be called functional centres of permanent excitation and inhibition, associated with stabilized, pathologically fixed, emotions and affections of a deleterious character. This pathological stasis embraces the vegetative nervous system and gives rise to a definite fixed functional state, corresponding to some chronic emotional stress. This morbid stasis, or inertness, may persist for a long time even after the external causes that produced it are removed.

The cortically conditioned pathological fixation of the vegetative nervous activity, by depriving it of its normal functional mobility and restricting the flexibility of its adaptation to changes in the organism's external and internal environments, leads to the development of phenomena of vegetative and metabolic dissociation, and also to disturbed activity of the internal organs. The site of major pathological disturbance and of greatest alteration of the physiological functions may differ in particular cases, depending on the peculiarities of the patient's ontogenesis and the diseases he has suffered from in the past. It is thus that disturbances of the higher nervous activity lead to somatic disorders.

It appears that, just as symptoms of pathological stasis, so may the so-called phasic processes spread from the cerebral cortex to the vegetative nervous system.

This new conception of the part played by the cerebral cortex in the pathogenesis of vegetative disorders and systemic diseases (especially in the case of peptic ulcer and hypertension) confronts the pharmacology of the higher nervous activity, as well as physiotherapy, with new and big problems. But this applies even more especially to psychotherapy, which, one would think, should be thoroughly reconstructed in the light of the basic laws of cortical activity and cortico-visceral relations, and in the light of Pavlov's theory of sleep inhibition, hypnosis, suggestion and, above all, the interaction of the first and the second signal systems.

Mention should incidentally be made of the exceptional interest shown in the application of Pavlov's teachings to clinical medicine by the Ukrainian psychiatrists, Professors V. P. Protopopov, K. I. Platonov, E. A. Popov and N. P. Tatarenko, and by the Georgian psychiatrists, Professors A. D. Zurabashvili and A. F. Gotsiridze.

What, then, are the principal problems and the principal prospects that confront the pathophysiology of the higher parts of the nervous system in the way of further developing Pavlov's ideas?

It seems to me that the chief of them are as follows.

First, to expand the experimental investigation of animals to the utmost, with a view to a more thorough and extensive study of simplified models of psychogenic and somatogenic, functional and organic, organic and somatic disorders of the nervous system; with a view, further, to a more extensive study of artificially induced disturbances of the interaction between the brain of animals and their external and internal environment; and with a view, lastly, to a more thorough elaboration of the experimental treatment of all these disturbances. And it is particularly necessary in this connection to stress the importance of studying the pathophysiology of higher nervous activity from the evolutionary and comparativ aspects and from the aspect of the influence of age.

Secondly, to develop from every aspect the clinical and, wherever admissible, the experimental clinical investigation of the higher nervous activity in various neuropsychic, nervous, and somatic disorders; to study the pathogenic nervous mechanisms of various diseases from the aspect of the pathophysiology of the higher parts of the nervous system; to study problems of constitution in the light of Pavlov's theory of types of nervous activity; to study the defensive nervous mechanisms formed in the process of evolution, such as protective inhibition; to study the nervous mechanisms underlying the therapeutic effect of various treatments, and the influence of the latter on higher nervous activity; to study the restorative processes in neuropsychic disorders, and the influence of the higher parts of the nervous system on the restorative processes in somatic diseases; lastly, to apply our knowledge of the nervous mechanisms of diseases in the elaboration of cures based on their pathogenesis, and also of the hygiene of the higher nervous activity.

Thirdly, to establish the closest possible contact and coordination between experimental research on animals and clinical investigations, between the pathophysiology of the higher nervous activity and practical medicine.

Here we must unswervingly follow Pavlov, whose whole scientific activity was invariably imbued by the urge to coordinate his researches with the needs of life, with the interests of medicine, with clinical practice.

But at the same time, be it noted, his work was never confined to narrow, specific, practical ends. The value of his scientific investigations, both practical and theoretical, for the most diverse departments of medicine is immense; but we know that their importance extends far beyond the boundaries of medicine, especially thanks to his concept of the first and second signal systems of the cerebral cortex.

Pavlov's researches are of indisputable value to psychology, pedagogics and linguistics. And there is a growing appreciation of their value to the philosophy of dialectical materialism. "In all the stages of his scientific work," Academician S. I. Vavilov says, "Pavlov unswervingly followed the strictly materialist path, and his astonishing results are recognized as a permanent and basic part of the natural-scientific foundations of dialectical materialism."

One important and urgent task confronting us is to train new cadres of young scientists in the fields of the physiology and pathophysiology of the higher nervous activity.

And so, given harmonious coordination of the efforts of our workers in science and public health, Pavlov's teachings are pregnant with fruitful possibilities for raising Soviet science, and especially Soviet medicine, to unprecedented heights. The fight to introduce Pavlov's teachings into various branches of Soviet medicine is prompted by concern for the health of our great people, for the welfare and happiness of our great Motherland, and for a medical science which will be fully worthy of the great Stalin epoch.

REPLY TO THE DISCUSSION

BY PROFESSOR

A. G. IVANOV-SMOLENSKY

You all remember what Comrade Stalin said on May 17, 1938, when he wished success to that science "which has the courage and determination to smash the old traditions, standards and views when they become antiquated and begin to act as a fetter on progress, and which is able to create new traditions, new standards and new views." Pavlov's science was precisely such a science. In the preface to the fifth edition of his *Twenty Years of Objective Study of the Higher Nervous Activity*, remarking that the book was essentially a history of the development of the theory of the higher nervous activity, he says: "Here, as in the history of all things, there have been, and are, many errors, inaccurate observations, wrongly arranged experiments, ill-founded conclusions; but there have also been many edifying instances when much of this was avoided or corrected, and in the main there has been a steady accumulation of scientific truth."

In Soviet science, an indispensable condition for the struggle of the new against the old, for the steady ascent of the ladder of development, is criticism and self-criticism. We disclose shortcomings and errors in scientific work in order to overcome them.

"It is generally recognized that no science can develop and flourish without a battle of opinions, without freedom of criticism," Comrade Stalin has said.

We have just seen how Pavlov regarded the process of overcoming his errors, and what importance he attached to it. It is quite clear to all of us here that the fundamental purpose of this session is to disclose and overcome shortcomings and errors in the work of carrying on and advancing Pavlov's teachings.

As I look back on my own thirty years and more of scientific work, I can see many shortcomings. Most of them have been overcome and corrected, but some of them are still in process of being overcome and corrected. It is quite probable that in my case, as in the case of every scientist, there are errors which escape my notice, and I shall be very grateful to those who are comradely enough to draw my attention to them.

There was undoubtedly a time when, in my investigations of the higher nervous activity of man, I did not properly appreciate its qualitative features; did not pay sufficient attention to the connections between the cortex and the vegetative nervous system; did not adequately correlate my scientific investigations of the higher nervous activity with the needs of clinical medicine; did not sufficiently appreciate the immense value of Sechenov's work in the study of the higher nervous activity of man; and when I sinned, as indeed very many others have sinned, in excessively citing in my works the authority of foreign scientists. Of one of the major shortcomings of my scientific work I have already spoken in my report.

In the speech of Academician L. A. Orbeli there were three things that are particularly worthy of attention. They are as follows.

First. Academician Orbeli entered into a controversy with some imaginary opponent as to whether a subjective world exists or not; and he regarded denial of the existence of a subjective world as a manifestation of Berkeleianism. But apart from the fact that subjective idealism, and hence Berkeleianism, does not consist in the denial of a subjective world, but, on the contrary, in the denial of an ex-

ternal material world, in the denial of objective reality—apart from this, the point at issue is not the denial of a subjective mental world at all. No one has ever asked, or now asks, Academician Orbeli to accept denial of the existence of a subjective world as correct. The point is not that anyone denies the existence of an internal mental world, which L. A. Orbeli calls subjective, but that this world, which reflects objective reality and which itself finds constant objective and external manifestation, is *not only subjective* but also objective, that it represents *a unity of subjective and objective.*

In regarding internal experiences and especially sensations as *only* subjective, Academician Orbeli tends towards subjective idealism; and in separating the objective nervous processes from "subjective sensations," his disciple, Professor Gershuni, seeks to provide an experimental basis for this idealist conception.

Secondly, a very interesting controversy arose between Academician Orbeli and Professor Grashchenkov over the question of direct impressions from the surrounding world and their verbal designations—a question, that is, which touches on the theory of symbols, or hieroglyphs. It must be confessed that this controversy led to nothing but confusion. Unfortunately, we have no time now to go into this question in detail, but allow me to say only one thing.

As we know, V. I. Lenin convincingly showed that Plekhanov was mistaken when, uncritically following Helmholtz, he did not regard sensations as "copies of real things and processes of nature," as dialectical materialism regards them, but as conventional signs, symbols, hieroglyphs of external phenomena, the erroneousness of which Lenin demonstrated.

A clear distinction must be drawn between this "theory of symbols" and the views of Sechenov and Pavlov. Sechenov *does use* the term "symbols," *but not in reference to sensations.* He gives this term a meaning entirely different from that of Helmholtz. Sechenov draws a distinction between *direct* "impressions of objects and phenomena of the external world"[1] and the *verbal symbols* or verbal designations of these impressions.[2] Under symbols he also classes natural miming and gesticulation, the conventional miming and gesticulation of the deaf-mutes, speech, writing, drawing and the entire system of mathematical symbols.[3]

Of course, symbols understood in this way have *nothing in common* with Helmholtz' "symbols-sensations." What Sechenov actually has in mind is the signalization used between man and man, social signalization, the means of human intercourse.

Pavlov speaks of direct impressions from diverse agents in the surrounding world, and of words pronounced, heard or seen (that is, written).[4] In other words, Pavlov differentiates between direct impressions and their verbal designations. It is on this basis that his theory of the first and second signal systems of the brain is founded.

I have cited these facts only in order to point to the necessity of exercising *extreme caution* when discussing the question of signs or symbols, and of strictly distinguishing between Helmholtz' view, which is to us entirely unacceptable, and the view of Sechenov and Pavlov. If this is not done, confusion is bound to arise, as was the case in the controversy you have heard between Academician Orbeli and Professor Grashchenkov—a confusion which was also reflected in the speeches of some of Academician Orbeli's disciples, Koltsova, for example.

Thirdly, Academician Orbeli, as indeed many others who spoke here, uses the expression: "Pavlov's theory of the second signal system." He talks about the problem of the second signal system in a number of his articles. This cannot be regarded as correct.

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[1] I. M. Sechenov, *Elements of Thought,* U.S.S.R. Academy of Sciences, 1943, p. 163.

[2] *Ibid,* p. 166.

[3] *Ibid.,* p. 164.

[4] I. P. Pavlov, *Complete Works,* Vol. III, p. 576.

Pavlov always and invariably discussed the question of the second signal system in inseparable connection with the question of the first signal system, from which the second signal system arises in the process of evolution, and from which *it cannot be separated.*

All Pavlov's typological and pathophysiological conceptions regarding these systems *are always based on their interaction.* I am profoundly convinced that the correct line of investigation is to study the history of the dynamic relations between these systems. All *our* investigations have long since been conducted along this line. Where the opposite view leads is shown by the following example: it has been repeatedly suggested at this session that the study of the second signal system should be entrusted to the Pedagogical Academy. Can it be considered expedient that the first signal system should be studied by the Academy of Medical Sciences, and the second signal system by the Academy of Pedagogical Sciences? The object of study of both Academies should be the integral organism of the child and the adult equally.

Academician Orbeli declared in his speech that the reporters, namely, Academician Bykov and myself, advertised their own accomplishments. K. M. Bykov does not stand in need of my defence. But I must say in my own defence that Academician Orbeli's reproach is quite unjust. Anyone who heard or read my report can confirm this. I said nothing in it about my accomplishments. Academician Orbeli also alleged that I claim to have anticipated Pavlov in the theory of the second signal system. But that is not true either.

I cannot understand why Academician Orbeli is so anxious to convict me of overrating my own person and of an absolutely morbid sense of self-importance.

I cannot refrain from referring, if only cursorily, to the speeches of Professors N. I. Grashchenkov and L. N. Fyodorov, the latter of whom, it seems to me, is absolutely correct. Both professors spoke as *old and faithful friends* of Pavlov's teachings. But how are we to explain that fact that in October 1937, by order of the People's Commissariat of Health of the U.S.S.R. (October 11) and of the All-Union Institute of Experimental Medicine (October 20), both the Pavlov clinics of the AUIEM—the neurological and psychiatric—were closed down. The latter was saved only with great difficulty, and the former was restored only two years later. The orders I have mentioned were signed by N. I. Propper-Grashchenkov, who was then acting People's Commissar of Health, and by L. N. Fyodorov, director of AUIEM.

About this same time, too, AUIEM's laboratory of comparative physiology of the higher nervous activity and its laboratory for the study of the higher nervous activity of children were closed down too. This is what *Pravda* wrote on June 7, 1941, in an article entitled "AUIEM Staff Conference": "It is well known that in the latter years of his life the great Soviet scientist I. P. Pavlov, having accumulated a vast amount of data, was nearing the goal of his researches—clinical work, the practical control of nervous and mental disorders. One would think that it should be the business of AUIEM, where disciples of Pavlov are working, to promote to the utmost these supremely important investigations, which have yielded such very promising results. As a matter of fact, however, the AUIEM, as Comrade Grashchenkov admits, has even taken a step, if not back, then at least away from the elaboration of Pavlov's legacy—away from the clinic, from highly acute problems of practical medicine."

How is all this to be explained?

A few words about the speech of Professor Ginetsinsky. According to Professor Ginetsinsky, practically the only mistake of Orbeli's school is that "it has allowed the experimental study of the problem of cortical regulation to escape from its hands." In other words, it displayed an obvious spirit of toleration and nonresistance to the fact that this problem was taken up by the school of another of Pavlov's disciples, and thus did not make this work its own exclusive monopoly. But what was there to prevent the question of cortical regulation being studied simultaneously by Orbeli's school and Bykov's school. How are we to understand this statement of Professor Ginetsinsky's? As subtle irony at the expense of self-criticism?

Professor Gershuni began his speech with a purely verbal admission of the erroneousness of his scientific views; but all the rest of his speech was an attempt to prove that they were correct, and in the end he adhered fully and entirely to his old erroneous position by asserting that sensation is nothing but a subjective experience.

Professor Gershuni thinks I am wrong in my understanding of Pavlov's view regarding the relation between the psychical and the physiological; he does not agree with my criticism of his subsensory reactions; he does not agree that his experimental data may be explained by the theory of the first and second signal systems, and asserts that "this is not the point here"; he insists that in the investigation of man's temporary connections the "subjective side of the phenomena" can be judged only from the "subjective descriptions" of the experimentee, and so on.

His attempt to prove the incorrectness of my views regarding the relation between the subjective and the objective by quoting *The Pavlov Wednesdays* is unconvincing. The notes of one of Pavlov's disciples and the stenographic reports which make up the three volumes of *The Pavlov Wednesdays* were never read, checked or initialled by Pavlov.

They contain many errors, inaccuracies and distortions of what Pavlov actually said, and this is true of the passage which Professor Gershuni quoted.

The questions Professor Gershuni put to me in his speech indicate that he did not listen to or read my report very attentively.

Professor Gershuni thought it appropriate to wax ironical over my criticism of his work. He said that this criticism had "reached a high concentration." I think Professor Gershuni would do wiser to eschew irony and give thought to a proper concentration of his own self-criticism, which is at a very low level. Professor Gershuni's irony undoubtedly springs from the same roots as that haughtiness of his to which Academician Bykov referred in his report.

Professor Kupalov replied to my criticism of his scientific views as follows: "Have we, then, lost our right to create new scientific terms and concepts and to systematize the new facts we have collected?"

No one is denying Professor Kupalov's right to move forward and collect new scientific facts. But drawing away from Pavlov and moving towards Beritov is not going forward and creating scientific values. Instead of replying to the substance of my criticism, Professor Kupalov assumes an air of injured innocence. I don't think this is calculated to help the advancement of Pavlov's teachings. No one wanted to offend Professor Kupalov, but I cannot agree with his concept of reflexes which have no beginning and no end —I cannot and will not agree, however offended he may be with me.

Professor Anokhin, while partially admitting some of his errors, devoted most of his speech to self-justification and to casting reproaches at the Pavlov school in general. He denies that he ever regarded Pavlov's theories as mechanistic. But even the editors of the journal which in 1936 printed his article, "Analysis and Synthesis in Pavlov's Work," deemed it necessary to furnish it with an editorial note saying that the opinion expressed in it that from the philosophical standpoint Pavlov's work is mechanistic was incorrect, and that "the objective significance of his work far transcends the bounds of mechanistic ideas."[1]

Professor Anokhin denies that he ever undertook a revision of Pavlov's conception of cortical inhibition. But here is a quotation from his last work, published in 1949 in the collection *Problems of the Higher Nervous Activity,* p. 93: " 'Inhibitory reactions' are entirely unknown to the animal organism; its reactions are always positive. . . ." In accordance with his usual custom, Professor Anokhin in this work invariably puts the expressions "cortical inhibition" and "inhibitory reactions" in inverted commas.

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[1] *Under the Banner of Marxism*, 1936, No. 9, p. 65.

Professor Anokhin says that he did not sufficiently stress the sources in Pavlov's teachings on which he drew when building his concept of the functional system. He thus continues to claim that the concept "functional system" does not belong to Pavlov and his school, but was created and formulated exclusively by Professor Anokhin. He is inclined to explain away the errors pointed out to him by attributing them, as K. M. Bykov said, solely to "vague and confused formulation."

Professor Anokhin's assertion that the reports of Bykov and Ivanov-Smolensky did not give a comprehensive idea of the paths of future development of Pavlov's teachings is absolutely unfounded.

As I have already said, Professor Anokhin admits his errors only partially and with all sorts of reservations, and does his utmost to diminish their significance; but he asserts that in the fourteen years since Pavlov's death, apart from Academician Bykov's work on interoceptive reflexes, Pavlov's school has made no progress whatever either forward or in depth. This slur on the Pavlov school is false. I would remind you only of the splendid work of M. K. Petrova, and of the work of Volborth, Asratyan, Usiyevich, Dolin and many other of Pavlov's disciples and collaborators, who to the best of their ability and opportunity have since the death of their great teacher been working lovingly to advance the ideas he bequeathed. Do not measure all Pavlovians by your own yardstick, Professor Anokhin!

I affirm that Professor Anokhin's self-criticism was not what it should have been in the interests of the fruitful advancement of Pavlov's teachings.

Now a few remarks about the speeches of the psychiatrists. It would be wrong to deny that there was a clear note of self-criticism in them, but only the future will show whether this self-criticism is effective and not merely declarative.

A word, in particular, about the speech of Professor Gurevich. Professor Gurevich denies that Pavlov did not recognize any particular part of the cerebral hemispheres as superior to the others, and asserts that Pavlov spoke many a time of a superior controlling function of the frontal cortex.

"Our facts," Pavlov said, "definitely discountenance the theory of separate associative centres and, in general, the existence of any special part of the hemispheres possessing a supreme nervous function."[1] But Pavlov did in a way regard the second signal system as a higher *system* of the brain, although he always stressed the danger of separating it from the first signal system, from the direct reflection of objective reality.

Therefore, we may speak only of a relative supremacy of the second signal system, which Pavlov really did consider an important, but not the exclusive, function of the frontal lobes.

"Psychoses," Professor Gurevich says, "are localized in the cortex." Every psychosis, in his opinion, is cortical, and related to those parts of the cortex which are specific to man. One of the German founders of so-called "cerebral pathology," Kleist, divides mental disorders into cortical and subcortical.

Professor Gurevich goes even further and tries to localize psychoses in definite areas of the cortex. This is fundamentally wrong. Psychoses are always manifestations of intricate disturbances of dynamic interactions both within the cortex and between the cortex and lower levels of the nervous system; they are disorders not only of the cortex, but of the brain in general—more, of the body in general.

Professor Gurevich provided an excellent illustration of the shortcomings of that narrow localizationism that is characteristic of the so-called "cerebral pathology" which I criticized in my report—of the shortcomings of the psychomorphological trend.

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[1] I. P. Pavlov, ***Lectures on the Work of the Cerebral Hemispheres***, 1927, p. 327.

Professor Gurevich believes that the subjective and objective are determined by consciousness. This is not true. Objective reality exists independently of consciousness.

Professor Gurevich is dissatisfied because I attributed the authorship of the so-called "theory of the integration, disintegration and reintegration of functions" to Sherrington and Professor Gurevich, and he holds that the concept integration is of earlier origin. Very well, I agree that this term is not only used by the English physiologist Sherrington, but that it was used even earlier by the English philosopher, and no less an idealist, Spencer. Let it be granted that the authors of the "theory of integration and disintegration" were not Sherrington and Gurevich, but Spencer and Gurevich.

How hard our psychiatrists find it to assimilate Pavlov's teachings! Take Academician Orbeli, for example. He has been working several years now in contact with the Moscow Central Institute of Psychiatry, headed by Professor Shmarian; they even have in common assistants who are working for their doctor's and master's degrees. But I have not seen a single work of the Institute in which this contact is reflected as far as the application of Pavlov's teachings to psychiatric problems is concerned.

A word or two about the speeches of the psychologists. They, too, undoubtedly contained healthy self-criticism. But in the speech of Professor Teplov, unfortunately, besides self-criticism there was nothing else.

I shall not dwell on the lines of further development of Pavlov's teachings, because I dealt with this subject in my report.

I welcome and associate myself with the speeches of Academician Bykov (with most of the views he expressed), and of Professors Volborth, Asratyan, Usivevich, Birman, Dolin and other of my colleagues of the Pavlov school.

I wish from the bottom of my heart that this session may in the end help to remove all obstacles to the further development of Pavlov's teachings and to promote their prosperous advancement in the interests of Soviet science, and above all of Soviet medicine.

I desire from the bottom of my heart that Soviet medicine, with the help of Pavlov's teachings and in full accordance with the wishes of J. V. Stalin, may rise to unprecedented heights.

Let all Pavlov's disciples and continuers of his work take as their model and example the life of I. P. Pavlov, which was illumined by an unswerving and passionate urge for scientific knowledge and scientific truth, his magnificent and glorious career of labour, the audacious flight of his creative thought, his ardent love for his people, his Motherland, and its science.

It is to all of us "a matter of honour to justify the great hopes reposed in science by our Country." (I. P. Pavlov.)

REPLY TO THE DISCUSSION

BY ACADEMICIAN

K. M. BYKOV

Dear comrades, permit me first to make a few general remarks on the work of this session. Everybody here agreed that the study of the human and animal organism must be based on the ideas of our great teacher Ivan Petrovich Pavlov. This applies not only to physiology, but to all the sciences that study the human and animal organism.

It must be stressed again that Pavlov is to be regarded not only as the originator of new chapters in physiology, but as a transformer of our whole science, as a great natural scientist in the broadest meaning of the term.

It seems to me that the transition from the conception of the organism as the sum of separately studied organs and systems to Pavlov's method of studying the integral organism in its natural relations with its external environment was no less a feat of scientific thought than the transition from Ptolemy's view of the world to the Copernican system.

And just as it was unthinkable, after Copernicus, Galileo and Newton, to return to the ideas of the astrologists, so it should be unthinkable, after Pavlov, to operate with the concepts of Virchow and Verworn, Johannes Müller and Sherrington.

Following the ideas of Pavlov means completely renouncing metaphysical ideas, which nowadays inevitably lead to the reactionary, idealist conceptions of the bourgeois servitors of imperialism.

We, the disciples and followers of Pavlov, are proud in the knowledge that the profound solicitude displayed by the Party, the Government, Comrade Stalin personally, and the entire Soviet people for the development of the ideas of our teacher, is due to the fact that Pavlov's consistently materialist teachings serve our people, our Country, and the practical work of building Communism. All the greater is the responsibility lying upon us effectively to promote Pavlov's ideas, and all the more insistently must we turn our face against every tendency to complacency, against inadequate criticism and self-criticism.

The discussion at this session confirmed that there was every reason to regard the situation in one of the most important branches of Soviet science as unsatisfactory.

Our President was right when he said that it was time to sound the alarm. It must be admitted that a number of highly important aspects of Pavlov's teachings are either not being advanced at all, or are being advanced inadequately. I must emphasize that I too share the responsibility for this. Nothing has been done to advance the theory of the second signal system, which is of cardinal importance, for it is here that physiology directly approaches man in the real conditions in which he lives, works and creates; not enough has been done in the study of internal inhibition; development of the researches so brilliantly begun by Pavlov in the psychiatric clinic has made little headway. Nothing of moment has been added in this field to what Pavlov himself succeeded in accomplishing. And many other important problems of the physiology of the higher nervous activity, as Professor Asratyan pointed out, have not been studied as they should.

Pavlov's ideas have hardly penetrated into the practical and research work of the clinic. They have not been extended at all to the physiology of farm animals, and have therefore been unable to contribute anything to practical socialist animal husbandry; Pavlov's principles have not found their way into biochemistry or pharmocology or hygiene. Yet all these sciences, whose object of study is the human and animal organism, are doomed to stagnation so long as they do not base themselves on Pavlov's creative principle of the unity and interaction of the organism with the surrounding world.

This session has shown that we have not done enough for the broad popularization of all aspects of Pavlov's teaching, and have not sufficiently combated a number of misinterpretations of his ideas. Not only were Beritov's views, which are profoundly hostile to Pavlov, insufficiently criticized; they even at times met with a certain amount of support from disciples of Pavlov—P. K. Anokhin, for example. And our own errors too have been rightly pointed out here. For instance, having discovered a new type of signals, proceeding from the internal organs, we erroneously called them a third signal system.

A number of opinions advanced by L. A. Orbeli might cause confusion as to the real character of Pavlov's supremely consistent materialism.

To this day we have not realized as fully as we should that effective promotion and propaganda of Pavlov's teachings is a very important sector of the ideological struggle. Only this can explain the fact that we have not subjected the reactionary opinions of foreign scientists and pseudo scientists to trenchant, militant, partisan criticism.

We have tolerated a state of affairs in which the physiology programs of all our universities do not reflect all the wealth of Pavlov's ideas and all their ideological significance. It is clearly time to put an end to this state of things. It is the disclosure of the big shortcomings which prevailed in our work, and which were noted by the majority of the speakers here, that constitutes the chief value of this session.

Workers in the allied sciences must certainly not wait for the physiologists to provide them, so to speak, with ready-made recipes for the application of Pavlov's principles to their fields. It would be fatal to replace creative application of Pavlov's teachings by dogmas, to replace effective work by mere declarations.

It must be repeated that only by maintaining a vigilantly critical attitude towards one's own work, only by paying heed to comradely criticism, can one guard against errors and mitigate the harm of errors already committed. Each of us must constantly bear in mind Pavlov's commandment—"Be watchful that pride does not master you"; and his counsel—"Do not be afraid to confess yourself an ignoramus."

The necessity must also be stressed of organizing our work in such a way as will ensure close and effective contact with one another.

Some of the speakers rightly pointed out that our central institutes work in isolation from one another and from our comrades in the provinces.

The caste spirit, the self-seclusion of some of the branches of the general Soviet school must be renounced once and for all.

Now a few particular remarks.

I want to point out that what I am about to say concerning L. A. Orbeli's statements relates to his first speech.

Leon Abgarovich, is it not understood that the talk about certain people having seized a monopoly of organization positions in science applies above all to you? Of the four institutions in which Pavlov worked, three are headed by you. It is you, therefore, that have been entrusted with the promotion of Pavlov's ideas, and in institutes that are better equipped than any in the Soviet Union—than any in the world, I would say. You were given scientific forces that worked with Pavlov in his day. It is therefore quite legitimate to ask how you have been directing these institutions, these forces, this wonderful wealth of facilities.

It is no use trying to escape these questions by a rude and overbearing attitude towards speakers at this session.

Your speech surprised not only us; it even surprised some of your disciples.

I am very pleased to note that a large number of your young pupils, despite the attempt to dominate their minds made by such a "scientific" director as Ginetsinsky, a man who had no understanding of Pavlov whatever, nevertheless had the honesty to admit their errors and to regard their teacher and their scientific director critically.

I am referring to the speeches of Volokhov, Khudorozheva and Cherkashin. Their speeches largely relieve me of the necessity of replying to the substance of your remarks; and what is more, I did not hear any denial on your part of the views expressed in my report.

I got the impression that you willfully refused to understand what was being said at this session.

You accused Grashchenkov of ideological illiteracy. But, in my opinion, you are guilty of similar illiteracy yourself.

How is it possible, for example, to make a distinction between Hering the philosopher and Hering the physiologist?

There was a great deal of confusion in what you said about the second signal system. Your interpretation of signals really does smack of Plekhanov. Nor have you renounced your psychophysiological parallelism.

I cannot dwell at length on this after the speech of Academician Alexandrov, who made a detailed analysis of your views.

Your jeering at our problem is offensive not to me, but to the large number of physicians who have demonstrated the correctness of our ideas in practice on the basis of an enormous amount of data.

You preferred to ignore our conference on cortico-visceral pathology, to which we specially invited you, otherwise you might have convinced yourself of this.

I came here in the knowledge that we would have full opportunity freely to express our thoughts and views, and what I said was prompted solely by the desire to help our common cause. I should have been glad to hear criticism of my work, not in the form of savage and rude attacks but in the form of businesslike and detailed criticism. I was therefore not affected a bit. And I want to say that I bear no grudge against L. A. Orbeli, and shall never refer to this subject again.

My attitude towards A. D. Speransky in this period has changed very little. I have always said and will say that Speransky's great service is that he was the first to establish the importance of the nervous system in the pathogenesis of disease, the first to point to the importance of the integral organism in pathology, thereby dealing a mortal blow to the old conservative cellular theory of Virchow. I note with satisfaction Academician Speransky's desire to bring his errors into the light of day. The fact that he confessed here that his attitude towards physiology had been incorrect, that he renounced the thesis that "the nervous system organizes the pathological process," that he admitted the role and significance of the cortex—all this can only redound to the benefit of Speransky himself and of our common cause.

This he might have done earlier, if he had not been hampered by certain assistants of his who were more interested in other matters than the great ideas of Pavlov.

I must note with satisfaction the speech of P. K. Anokhin, who admitted many of the errors he committed in attempting to revise Pavlov's teachings—not only "after the death," as he says, but even during the lifetime of our great teacher.

I think that in this case, as in others, one should not endeavour to justify one's errors either in one's writings or one's experimental work by referring to what Pavlov supposedly said in conversation.

All the same it must be said that P. K. Anokhin did not disclose the essence of his misguided views, nor the motives that governed him when he endeavoured to impose his ill-founded concept of what he calls functional systems and his theory of the integral role of the cortex, which, it is true, he borrowed from West-European scientists.

I think that P. K. Anokhin, with his great industry and experience in experimentation, will be able to take the correct Pavlov line and will bring benefit to our Soviet science.

Comrade Dzidzishvili's speech was quite incomprehensible. Instead of giving a proper analysis of the errors of his teacher, Academician Beritov, he preferred to hush them up—even more, he tried to ascribe many of Pavlov's discoveries to Beritov. Who needs this childish naiveté, to call it nothing worse? The question at issue is far more serious than Comrade Dzidzishvili thinks. We find conservative views seeping into our country from abroad all the time. This must be combated. And a particularly important part in doing so must be played by our young Soviet-formed scientists, the scientists trained under the Soviet system.

The speech of Comrade Shatenstein was strange. He came forward as a repentant sinner. But he gave no analysis whatever of the errors of certain co-workers of Stern, who have not laid down their arms to this day. Mere words are not enough, nor are they of any value to the cause.

It is astonishing how many "Pavlovians" have appeared at this session. Unfortunately, these "Pavlovians" were until very recently trying to destroy rather than promote the Pavlov trend. This we have heard here from Professors Volborth and Yemchenko, who sharply criticized the activities of Comrade Babsky.

I am thankful to Babsky for having helped me in criticizing my own textbook. But I do not consider this an honour. I have spoken about my textbook many times myself, so nobody will be convinced by this method of hiding behind the back of another. First smuggling in alien views, then combating our own Soviet schools, and then, when exposed, repenting one's "sins"—all this is the usual tactics of cosmopolitans.

Allow me to quote a few lines from one of Mikhalkov's fables:

There still are some who at their table
All things Soviet with scorn abuse,
And oily admiration ooze
Of all that bears a foreign label,
Yet—Russian bacon can't refuse!

I shall now, with your permission, touch upon some other speeches. I agree with Comrade Usiyevich that we have done little to unite the efforts of the schools in the investigation of individual problems.

What was said about invitations to the conference is not quite correct. It was our endeavour to invite everybody, but, unfortunately, not everybody responded to our invitation. In my opinion, conferences on individual problems should be convened regularly, and not only in Moscow or Leningrad.

I fully agree with the critical remarks regarding our departure from specific scientific work.

E. A. Asratyan is right when he says that we are unable to devote ourselves fully to science "at the bench," because we are overburdened with parallel jobs, administrative functions, conferences, and so on and so forth. But I must point out that in our Soviet conditions we cannot renounce the role of "organizers of science." We cannot imitate the scientists abroad, for whom science is a private matter, and who are not concerned about the training of scientific cadres. Science in our country is organized in the general interest of the state, and on an incomparably bigger scale than abroad. "Departure" from these questions, and confining oneself to the narrow sphere of laboratory interests, is therefore not the style of the Soviet scientist. But I fully agree that the work of science organization might be laid more boldly on the shoulders of our splendid youth, whose mission it is to consummate the revolution in science. Our duty in this respect is to help them to the utmost.

Reference must be made to the speeches of the microbiologists, and especially the speech of A. V. Ponomaryov. He spoke rather fully of the importance of applying Pavlov's ideas to the theory of immunity, as a protective function of the organism. He pointed out that to this day, despite the fact that the role played by the nervous system in many of the immunity reactions of the organism had already been indicated by Mechnikov and others—that in spite of this, Pavlov's views to this day are practically not being applied in this important branch of prophylactic medicine.

A. V. Ponomaryov remarked that Professor Zdrodovsky had spoken here of utilizing Vvedensky's work in the study of immunity, but that to apply the ideas concerning the basic processes of inhibition and excitation to complex reactions only in general form, without an adequate analysis of the concrete facts of immunity, would be unwise.

On the subject of the importance of Pavlov's teachings to hygiene, we have had two speeches at this session—one by Professor P. N. Lastochkin, the other by Academician F. G. Krotkov, chief of the department of hygiene, microbiology and epidemiology of the Academy of Medical Sciences of the U.S.S.R.

Of all the wealth of Pavlov's teachings, Professor F. G. Krotkov found it possible in his speech to recommend the application to hygiene only of the method of conditioned reflexes, and even this he expressed in the most general form. He thereby sharply narrowed the broad potentialities and prospects of applying Pavlov's teachings, reducing them merely to laboratory study, as is done in foreign textbooks. But Comrade Krotkov did not mention, as an academician and chief of a department of hygiene should have done, the great achievements of hygiene in the period of Soviet rule. More, Comrade Krotkov formulated quite incorrectly the conclusions drawn and the general character of the speeches made at the recent discussion on hygiene in the Academy of Medical Sciences, thereby giving an erroneous idea of the scientific trend of Soviet hygiene and, in particular, of the work of the Institute of General and Municipal Hygiene and of its director, A. N. Sysin.

Professor P. N. Lastochkin, on the contrary, did give a detailed critical analysis from the standpoint of Pavlov's teachings of the basic problems of hygiene, utilizing the data of the Pavlov school.

I should like to mention the speech of Comrade Pletnev, who drew attention to, and gave a good description of, Pavlov's role in the investigation of problems of veterinary medicine and animal husbandry.

I cannot, unfortunately, dwell on the speeches of all the comrades, nor can I answer a number of written questions I have received, particularly as these questions do not concern matters of principle, but only certain aspects of Pavlov's legacy.

We must realize the seriousness of the great work we are embarking on. It is bound to entail an upheaval. I should like to quote the words of our eminent scientist A. F. Samoilov in this connection: "Everyone who is familiar with the modern theory of conditioned reflexes knows that before one can master and assimilate the principles of this theory, there must be a certain upheaval in one's customary habits of thought. The necessity for such an upheaval has accompanied many great discoveries and new ideas. When the idea was first advanced that the earth is spherical, man had to undergo a painful process before he could accept this idea: a certain strain of effort was required, a certain upheaval of customary ideas, to grasp that the people at the antipodes stand just as firmly and confidently on their spot of the planet as we on ours."

We have seen how painfully mankind reacts to such a demand. A similar upheaval in our customary ideas is required in the study of conditioned reflexes. And this upheaval Pavlov systematically performed in his laboratory.

In conclusion, I must say that the tasks set before this session have been accomplished. We have had another opportunity to convince ourselves of the fruitfulness of the method of constructive scientific discussion.

Indeed, it is only by this method that we can most quickly put an end to the old and moribund, and clear the way for everything new and progressive.

The session has already evoked a broad response in our country. There is no corner of the land where it has not aroused interest. We must realize and appreciate this concern of a great people, which loves science, takes an interest in it, and shares our solicitude for its fate.

We should be grateful to our dear teacher and leader, that titan of science, Joseph Vissarionovich Stalin, who has set Soviet scientists the great task of mustering all the might of science in the building of communist society.

May our advanced Soviet science flourish, to the glory of our Country and the benefit of all progressive humanity!

Glory to the people that has taken upon itself the epoch-making mission of building a classless communist society!

Glory to the leader of this people, the great Stalin!

RESOLUTION OF THE SCIENTIFIC SESSION

OF THE ACADEMY OF SCIENCES OF THE U.S.S.R. AND THE ACADEMY OF MEDICAL SCIENCES OF THE U.S.S.R. ON THE PHYSIOLOGICAL TEACHINGS OF ACADEMICIAN

I. P. PAVLOV

Having met to discuss problems of the physiological teachings of Academician I. P. Pavlov, and having heard and considered the report of Academician K. M. Bykov on "Development of the Ideas of I. P. Pavlov (Tasks and Perspectives)" and the report of Professor A. G. Ivanov-Smolensky on "Lines of Development of I. P. Pavlov's Ideas in the Pathophysiology of the Higher Nervous Activity," this scientific session of the Academy of Sciences of the U.S.S.R. and the Academy of Medical Sciences of the U.S.S.R. expresses its full approval of these reports.

The objective natural-scientific method of investigating the vital functions of the organism founded by the great Russian physiologist I. P. Pavlov, his original researches into the physiology of blood circulation, his theory of digestion and trophic innervation, and especially his brilliant theory of the higher nervous activity, mark a new era in the development of creative natural science.

The Communist Party, the Soviet Government, and V. I. Lenin and J. V. Stalin personally, highly appreciated the value of Pavlov's scientific work and displayed exceptional solicitude for its advancement. Very favourable conditions have been created in our country for the development of Pavlov's scientific legacy.

In this field, Soviet physiology has a number of major achievements to its credit.

Pavlov's idea that all the important vital functions of the organism are regulated by the cerebral cortex has been broadly developed. These researches are of essential importance for the advancement of clinical medicine.

New data have been obtained throwing light on the conditioned-reflex mechanism in the behaviour of animals, and on the evolution of temporary connections. Definite progress has been made in the field of the pathophysiology of the higher nervous activity of animals and man, in elucidating the dependence of a number of pathological processes on the state of the cerebral cortex, and in determining the role of the cerebral cortex in the restoration of disturbed functions in the injured organism, as well as in the application of sleep therapy in various disorders.

On the basis of Pavlov's theory of trophic innervation of the tissues, new data have been obtained regarding the trophic function of the nervous system. The Botkin-Pavlov idea of "nervism" in pathology, the idea of the importance of the nervous system in the origin, course and issue of pathological processes, has been advanced. Pavlov's classical investigations of the physiology of the digestive processes have been carried a stage further. His ideas regarding the internal receptors of the organism are being developed.

In the main, however, the practical and theoretical results of the work of developing Pavlov's scientific legacy, and in particular, of investigating the higher nervous activity, fall far short of what was expected from the disciples and followers of the great scientist, and are altogether incommensurate with the facilities provided for this work by the Soviet Government and the Party. The work of developing Pavlov's scientific legacy has in many respects not followed the broad highway of Pavlov's ideas.

The advancement of Pavlov's ideas and the application of his theories to medicine and biology have met with fierce resistance from Stern and her "school," who preach various metaphysical, pseudoscientific conceptions which reflect the influence of reactionary scientists in the capitalist countries, and which have worked to the detriment of our science. Mention must also be made of the fight waged against Pavlov's teachings by Academician I. S. Beritov and certain other idealist-minded physiologists and psychologists, as well as psychiatrists and neuropathologists.

Academician I. S. Beritov has long been campaigning against the ideological foundations of Pavlov's theory of the higher nervous activity, without meeting with a proper rebuff from the majority of Soviet physiologists. It is not for nothing that Academician Beritov's anti-Pavlov activity has the support of reactionary scientists.

The promotion of Pavlov's ideas in medicine has likewise been hampered by the wide prevalence of unscientific Virchowian ideas in pathology.

Certain science workers in a number of the leading institutions that were entrusted with the task of promoting Pavlov's teachings, far from heading the struggle against pseudoscientific, anti-Pavlov trends, have themselves departed from Pavlov's ideas on a number of basic problems, and have endeavoured to revise many of his cardinal theses.

It was fully revealed at the session that Academician L. A. Orbeli and a group of his closest disciples (Professors A. G. Ginetsinsky, A. V. Lebedinsky, A. M. Alexanyan and others) have followed incorrect paths, have misled investigators and have retarded the development of Pavlov's teachings. The free discussion at this session disclosed the erroneous position of Academician Orbeli, who in a number of instances has substituted his own mistaken views for the views of I. P. Pavlov.

The unsatisfactoriness of Academician Orbeli's position was fully revealed in the pointless speech he made at this session, in which he in effect evaded a reply to the criticism levelled at him.

The session notes that, as the director of the major Pavlov institutes—the Pavlov Physiological Institute of the Academy of Sciences of the U.S.S.R. and the Pavlov Institute of Evolutionary Physiology and Pathology of the Higher Nervous Activity of the Academy of Medical Sciences of the U.S.S.R.—Academician Orbeli diverted the work of the scientific personnel of these institutions from the fundamental problems of Pavlov's scientific legacy and, while formally proclaiming himself an adherent of Pavlov's teachings, actually distorted a number of his basic concepts.

In their investigations of the adaptive-trophic influence of the sympathetic nervous system, Orbeli and his disciples, in defiance of Pavlov's teachings, disregarded the leading role of the cerebral cortex.

Orbeli ignored Pavlov's theory of the analyzers in his work on the physiology of the sense organs. He and some of his collaborators expressed views which were tantamount to psychophysical parallelism.

Work on the genesis of the higher nervous activity was altogether unsatisfactory. As a consequence of Academician Orbeli's formal-geneticist views, this problem was studied in divorcement from the principles of Michurinian biology.

Investigation of the second signal system of the human cerebral cortex was inadequate and conducted on incorrect lines, and furthermore in isolation from the first signal system.

Problems of the pathophysiology of the higher nervous activity received insufficient attention in the Leningrad institutions, as a result of which the ties between the physiological institutions headed by Academician Orbeli and the clinic were weakened.

Scientific criticism and self-criticism were not practised in the bodies headed by Academician Orbeli, and measures were not taken to ensure freedom of criticism and a battle of opinions. Laudation of scientific leaders and blind submission to their "authority" were the prevailing spirit in these institutions.

As the head of a large number of research institutions, university chairs, scientific commissions, journals and societies, Academician Orbeli held a monopoly position in physiology, which is intolerable, since it is contradictory to the spirit of Soviet science and hampers its free development.

The discussion has shown that Academician Orbeli and a small group of his followers had insulated themselves from the main body of Soviet physiologists, who are following the correct Pavlov path.

The session takes note of Academician Orbeli's statement that the criticism at this session has led him to see the erroneousness of his first speech and that he recognizes the incorrectness of his position. However, Academician Orbeli did not in this statement either give a lucid criticism and analysis of his errors.

Academician A. D. Speransky rightly stressed the significance of the nervous system in the development of pathological processes, and sharply criticized the Virchowian ideas in pathology. But there have been a number of errors in his own work. He has not drawn to the full on Pavlov's rich scientific legacy in his investigation of the trophic function of the nervous system.

Academician Speransky's view of the role of the nervous system in pathology ignored the leading part played by the cerebral cortex in the activity of the integral organism, and advanced instead of this the confused concept of the "nervous network."

Academician Speransky and his disciples did not attach proper importance to disclosing the physiological mechanisms of pathological processes, and instead introduced the vague concept of the organizing role of the nervous system.

Professor P. K. Anokhin has not promoted Pavlov's teachings, and for many years has devoted himself to revising the ideological foundations of Pavlov's materialist theory of the higher nervous activity and minimizing its importance.

While professing to be an adherent of Pavlov, Professor Anokhin characterized his scientific method, his theory of the higher nervous activity, and our Soviet physiology generally, as analytical and one-sided, which in practice coincides with the opinion of Pavlov's foreign "critics."

Professor P. S. Kupalov, in his interpretation of his experimental data, has not infrequently departed from Pavlov's teachings.

There have likewise been shortcomings in the work of certain other disciples and followers of Pavlov.

This session condemns the unjustified tendency of certain scientists to create their own physiological "schools" and thus set themselves in opposition to the general trend of Pavlov's teachings.

The session draws attention to the inadequate application of Pavlov's teachings to medicine; the great scientist's maxim that physiology must become the scientific basis of medicine has not been observed.

This is primarily due to the fact that the Ministry of Health of the U.S.S.R. and its Scientific Council, the Ministry of Higher Education of the U.S.S.R., and the Department of Biology of the Academy of Sciences of the U.S.S.R. underrated the importance of Pavlov's teachings as the natural-scientific basis of biology and medicine.

The responsibility of the Presidium of the Academy of Medical Sciences of the U.S.S.R. for this state of affairs must be particularly noted, since it has not paid adequate attention to the introduction of Pavlov's ideas into medicine, and has not seen to it that the medical research institutes devote themselves to the development of Pavlov's teachings.

The blame for this is also shared by Pavlov's disciples and followers, many of whom in their work disregarded the needs of Soviet medicine and did not sufficiently propagate Pavlov's ideas among the broad body of physicians.

The inadequate penetration of Pavlov's ideas into medicine, as well as into psychology, pedagogics, physical training, veterinary surgery and animal husbandry, is also to be explained by the fact that Pavlov's teachings have not held the leading place in university curricula and textbooks.

The manual compiled by Professors A. G. Ginetsinsky and A. V. Lebedinsky, *Principles of the Physiology of Man and Animals,* not only falls short of the elementary requirements of a Soviet textbook, but reflects a conservative attitude towards Pavlov's teachings as the basis of modern physiology.

These shortcomings are also to be observed in the textbook edited by Professor E. B. Babsky. Pavlov's teachings and the achievements of Soviet physiology are inadequately reflected in the textbook edited by Academician K. M. Bykov.

On the other hand, the session notes with deep satisfaction that Pavlov's ideas have completely triumphed in Soviet science.

Pavlov's outstanding scientific achievements in establishing that all forms of vital activity of the complex organism, including mental activity, are determined by its conditions of existence, have advanced our Soviet physiology to the foremost place in the world, and opened up broad prospects for its further advancement. They have created a firm natural-scientific foundation for the reconstruction of medicine and psychology on scientific lines; they are of great value to pedagogics and physical training, and may be of great value to linguistics. Pavlov's discoveries in the realm of the higher nervous activity, which are supreme achievements in the modern science of the brain, constitute a mighty natural-scientific foundation of the materialist world outlook, and a formidable weapon in our ideological struggle against all manifestations of idealism and obscurantism.

The discussion at this session has made it abundantly clear that there is in our country a vast body of scientific workers who are capable of constructively developing and applying Pavlov's teachings in all branches of physiology, medicine, psychology and agriculture, and of properly directing the activities of our country's physiological and medical institutions.

With the aim of further developing Pavlov's teachings and bringing them into closer contact with practice, this session resolves:

1. To instruct the Presidium of the Academy of Sciences of the U.S.S.R. and the Presidium of the Academy of Medical Sciences of the U.S.S.R. to decide without delay what organizational and scientific measures must be taken for the further development of the theoretical foundations of Pavlov's teachings, and for the application of his teachings to practical medicine, pedagogics, physical training and animal husbandry.

2. To instruct the Presidium of the Academy of Sciences of the U.S.S.R. and the Presidium of the Academy of Medical Sciences of the U.S.S.R., and to request the Ministries of Higher Education and Health of the U.S.S.R., to revise the current year's and the long-range plans of scientific work in the various branches of physiology and medicine (internal medicine, hygiene, psychiatry, neuropathology, etc.). The keynote of these plans should be broadly organized research for the advancement of Pavlov's ideas and trends of research, special attention being paid:

a) to research in the physiology and pathology of the higher nervous activity of animals and man;

b) to study of the second signal system in its interaction with the first signal system;

c) to study of the trophic function of the nervous system;

d) to investigation of the functional interrelations between the cerebral cortex and the internal organs;

e) to broader experimental investigation of the genesis of the higher nervous activity;

f) to extending the work on the physiology of digestion, blood circulation and respiration;

g) to advancing Pavlov's scientific ideas in the realm of general pathological physiology, and, in particular, in respect to the role of the cerebral cortex in the restoration of disturbed functions of the organism;

h) to experimental study of cardinal problems of clinical and prophylactic medicine, and to the elaboration of new methods of treatment based on Pavlov's teachings;

i) to research in the physiology and ecology of farm animals.

3. To stress the necessity of the adoption by the Ministry of Higher Education of the U.S.S.R. and the Ministry of Health of the U.S.S.R. of the following measures in the training of scientific forces:

a) revision of the physiology programs in universities and in pedagogical, veterinary and agricultural colleges, as well as of the teaching programs in the principal departments of medicine, with a view to their reconstruction on the lines of Pavlov's physiology;

b) introduction of an obligatory course on the principles of the physiology (and pathology) of the higher nervous activity in universities, medical colleges, the senior classes of pedagogical colleges, and in refresher institutes for physicians;

c) holding of contests for the compilation within the next two years of the best textbooks on physiology and pathological physiology for universities and medical, pedagogical, agricultural and physical-training colleges, based on Pavlov's ideas and the achievements of Soviet physiology;

d) wide introduction, with a view to promoting Pavlov's methods of instruction, of the teaching of physiology by means of lectures, with demonstration of experiments and practical work, and reintroduction of the posts of lecturers' assistants;

e) inclusion of an obligatory course of physiology in the program for medical postgraduates.

4. To instruct the Academy of Science of the U.S.S.R. and the Academy of Medical Sciences of the U.S.S.R.:

a) to make a practice of convening annual scientific conferences for the businesslike and critical discussion of specific problems of the Pavlov physiology, especially problems of the physiology and pathology of the higher nervous activity;

b) to encourage the growth of scientific forces in the physiology and pathology of the higher nervous activity through postgraduate and doctorate bursaries;

c) to take measures for the founding of a new scientific journal specially dedicated to problems of the higher nervous activity.

5. To stimulate broad discussion of the basic problems of Pavlov's teachings in the periodicals of the Academy of Sciences of the U.S.S.R., the Academy of Medical Sciences and the Ministries of Higher Education and Health.

The session calls upon all workers in the fields of physiology and medicine to help, by means of open scientific criticism and self-criticism, to promote the constructive development of Pavlov's great teachings for the benefit of the people.

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